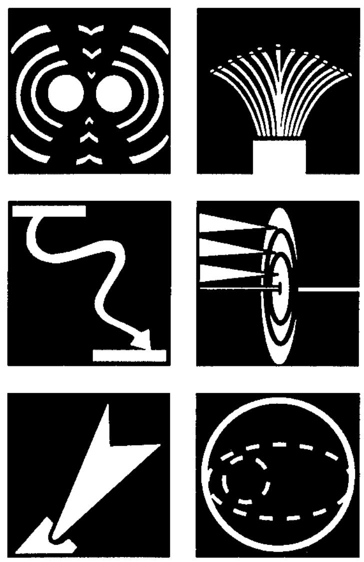
BULLETIN
OF THE AMERICAN PHYSICAL SOCIETY

OSA
ANNUAL MEETING



AND
EXHIBIT
Sponsored by
the Optical Society of America

ILS–X
10TH INTERDISCIPLINARY
LASER SCIENCE
CONFERENCE
Sponsored by the Laser Science
Topical Group/APS in cooperation
with the Optical Society of America

Program of the 1994 Interdisciplinary Laser Science Conference (ILS-X)

October 1994
Volume 39, No. 4

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The *Bulletin* is delivered, on subscription, by 2nd Class Mail. Complete volumes are also available on microfilm. **APS Members** may subscribe to individual issues, or for the entire year. **Nonmembers** may subscribe to the Bulletin at the following rates: Domestic $330; Foreign Surface $340; Air Freight $350. Information on prices, as well as subscription orders, renewals, and address changes, should be addressed as follows: **For APS Members**—Membership Department, The American Physical Society, One Physics Ellipse, College Park, MD 20740-3844. **For Nonmembers**—Circulation and Fulfillment Division, The American Institute of Physics, 500 Sunnyside Blvd., Woodbury, NY 11797. Allow at least 6 weeks advance notice. For address changes, please send both the old and new addresses, and, if possible, include a mailing label from a recent issue. Requests from subscribers for missing issues will be honored without charge only if received within 6 months of the issue's actual date of publication.

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BULLETIN OF THE AMERICAN PHYSICAL SOCIETY

Series II, Vol. 39, No. 4, October 1994

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PROGRAM OF THE 1994 INTERDISCIPLINARY LASER SCIENCE CONFERENCE

(1994 Annual Meeting of the Laser Science Topical Group of the APS, held jointly with the OSA Annual Meeting)

October 2–7, 1994

Loews Anatole Hotel, Dallas, Texas

GENERAL INFORMATION

The 1994 Interdisciplinary Laser Science Conference (ILS-X)— to be held October 2-7, 1994 at the Loews Anatole Hotel in Dallas, Texas, is the tenth in the ILS Conference Series. This conference is the annual meeting of the Laser Science Topical Group (LSTG) of the American Physical Society (APS) in cooperation with the Optical Society of America (OSA). The ILS Conference series, first held in Dallas in 1985, was established to survey the core laser science areas, including lasers and their properties, nonlinear optical properties, applications of lasers in physics and chemistry, and a selection of laser applications in other areas of science and technology. Authoritative plenary and invited lectures will be presented along with numerous contributed papers on recent research results of interest to the community. The 1994 ILS Conference is colocated with the OSA Annual Meeting (October 2-7). Coordinated joint symposia will be held with the OSA.

Consult the Epitome on page 1338 and the Main Text (beginning on page 1341) for the schedule of the ILS and joint papers. The entire ILS and OSA Annual Meeting schedule of papers and compilation of 50-word abstracts are available by calling the OSA Conference Services Department at 202/223-0920. Copies will also be available on-site.

POSTER SESSIONS

There are 147 posters scheduled for presentation. They can be viewed at the following times in Trinity Hall:

Tuesday, October 4, 1994

TuEE, OSA Poster Session: 1	5:30–7:00pm
TuFF, ILS Poster Session: 1	5:30–7:00pm
TuHH, Vision Technical Group Posters	8:00–10:00pm

Wednesday, October 5, 1994

WWW, OSA Poster Session: 2	5:30–7:00pm
WXX, ILS Poster Session: 2	5:30–7:00pm

Poster-paper presentations provide for an intimate interaction between the presenter and viewer. Viewers only casually interested in the paper can look over the material, ask for whatever clarification is desired, and move on. Viewers sufficiently interested in the work displayed may choose to engage the presenter in the lengthy discussion.

Each author is provided with a 4-ft. high × 8-ft. wide bulletin board on which to display a summary of the paper. Authors will remain in the vicinity of the bulletin board to answer questions. **Please note that no audio-visual equipment is provided or allowed for poster sessions.**

SHORT COURSE INFORMATION

The Annual Meeting short course program consists of seven full day, two 6-hour, and four half-day short courses. These courses are offered on **Sunday, October 2, 1994**, with the exception of SC113, which will be held on Monday, October 3. The tuition rates to attend the short courses are:

	Before September 1	At the Meeting
Half-day course	$110	$160
6-hour course	$150	$200
Full-day course	$190	$240

To preregister, complete the enclosed meeting registration form and mail to OSA before September 1, 1994. Attendees are advised to preregister for their own convenience and assurance in attending the course.

For details regarding the short courses, as well as other program information, call the OSA Conference Services Department at 202/223-0920 or FAX 202/416-6100.

REGISTRATION

Registration will be held in the Chantilly Foyer of the Loews Anatole Hotel in Dallas, Texas.

Sunday, October 2, 1994	11:00am–9:00pm
Monday, October 3, 1994	7:00am–6:00pm
Tuesday, October 4, 1994	7:00am–5:30pm
Wednesday, October 5, 1994	7:30am–5:30pm
Thursday, October 6, 1994	7:30am–5:00pm
Friday, October 7, 1994	8:00am–12:00pm

REGISTRATION FEES

The registration fee for the OSA/ILS'94 includes admission to all technical sessions, admission to the conference reception, admission to the technical exhibit, one copy of the *Bulletin of the American Physical Society*, one copy of the OSA Engineering How-To notes, all scheduled refreshment breaks, and admission to the technical exhibit.

Please note that there is a separate fee for short courses.

	Before September 1	At the Meeting
OSA/APS-LSTG member	US$275	US$325
Nonmember	US$335	US$385
Full-time student	US$85	US$105
Emeritus member	US$85	US$105

To avoid duplicate charges, please do not mail and fax your registration form.

Student and Emeritus members of the OSA and APS-LSTG will be entitled to the same privileges as regular registrants. Students should be prepared to provide full-time student identification at the time of registration.

ONE-DAY REGISTRATION FEE

A one-day registration fee is available for those unable to attend the entire technical conference. This fee includes admission to the technical sessions, coffee breaks, and technical exhibit, but does not include admission to the conference reception.

Before September 1: $160

At the meeting: $190

REFUND POLICY FOR PREREGISTRATION

There will be a $35 service charge for processing refunds. A letter requesting the refund should state the preregistrant's name and to whom the check should be made payable. Requests for preregistration refunds that are received no later than seven working days prior to the first day of the meeting will be honored. NO REQUESTS FOR REFUNDS WILL BE CONSIDERED AFTER SEPTEMBER 22, 1994.

HOTEL ACCOMMODATIONS

The conference is being held at the Loews Anatole Hotel in Dallas, Texas. The majority of the rooms are at the Loews Anatole Hotel, although a small block of sleeping rooms have been reserved for the convenience of the conference attendees at the following hotels within a very easy walking distance to the Loews Anatole Hotel :

Loews Anatole Hotel	$108 Single	$118
	$80 interior rooms (no outside windows)	
Stouffer Dallas Hotel	$105 Single	$115
Courtyard by Marriott-Market Center	$89	$109
Holiday Inn Market Center	$67	$77

All rooms are subject to state and local taxes. **The conference rates will not be honored after the reservation deadline of August 31, 1994.**

All reservations are being coordinated by the Dallas Housing Bureau. To reserve a room, you must use the housing form enclosed. Please follow the instructions listed on the form to facilitate processing of your request. **All reservations must reach the Housing Bureau by AUGUST 31, 1994.** Conference rates are not guaranteed after the deadline. Please mail your hotel accommodations form to:

Dallas Housing Bureau
1201 Elm Street, Suite 2000
Dallas, Texas 75270

International attendees may fax their housing forms to (214) 746-6693.

TRANSPORTATION

OSA has selected Delta Air Lines, Inc. and Cal Simmons Travel as the official air carrier and agency for our meeting. Delta is offering special discounted meeting fares! To take advantage of Delta's quality service, convenient schedules and special fares, simply call one of the following:

1. **Cal Simmons Travel at 1-800-875-9820**.

2. **Delta Airlines at 1-800-241-6760** from 8:00am-11:00pm EDT, daily. Please refer to File Number **J0708** when making your reservations.

(Applicable restrictions must be met. Seats are limited).

The distance to downtown Dallas from DFW International Airport is 18 miles or a 20-minute drive. The Loews Anatole Hotel is located about five minutes from downtown in the Market Center area of the city. Approximate cost via airport transportation (shuttle) is $10, and approximate cost via taxi is $20.

MEETING SERVICES

AUDIO-VISUAL EQUIPMENT

Each meeting room will contain the following audio-visual equipment:

- Podium microphone
- Lavalier microphone
- 2x2-in. (35-mm) slide projector
- Overhead projector
- projection pointer (laser)

Additional equipment will be made available **only** by special request prior to the meeting. Contact the OSA Conference Services Department with your request for all additional equipment before Friday, September 23, 1994. Authors requesting video projection equipment will be provided VHS 1/2-inch format only. Equipment will be guaranteed if the request is received by the September 23 deadline.

SPEAKER AND PRESIDER CHECK-IN

To ensure that the program runs smoothly, all speakers and presiders are requested to report to the Slide Preview located in the Emerald Room on the main level of the Loews Anatole Hotel.

Authors are requested to preview and preload their 2x 2-inch slides on the day of presentation, at least 30 minutes prior to the start of their session. Slide trays will be provided. Speakers are urged to retrieve their slides at the Slide Preview Desk immediately following their session.

Presiders are requested to identify themselves to the audio-visual personnel for a quick review of equipment and procedures. The slide preview hours will be:

Monday, October 3	7:30am–6:00pm
Tuesday, October 4	7:30am–4:30pm
Wednesday, October 5	7:30am–6:00pm
Thursday, October 6	7:30am–8:00pm
Friday, October 7	7:30am–2:00pm

STUDENT EMPLOYMENT

Students are needed to work as audio-visual projectionists and badge checkers in the technical session rooms. Work benefits include waived registration fees for working two full days and monetary compensation. You must be a full-time undergraduate or graduate student. Assignments are made on a first-come, first-served basis. To sign up, please call the OSA Conference Services Department at 202/223-0920.

COFFEE BREAKS

The registration fee includes refreshments served in Trinity Hall from 10:00am-10:30am Monday through Friday, and 3:00pm-3:30pm Monday through Thursday. Concession stands will be open in Trinity Hall where refreshments will be available for purchase. Additionally, there are numerous restaurants and fast-food outlets throughout the Loews Anatole Hotel.

CONFERENCE RECEPTION

All paid OSA Annual Meeting/ILS attendees and exhibitor personnel are invited to attend the wine and cheese reception to be held on Wednesday, October 5, 1994 from 7:00pm-8:00pm in Trinity Hall. Join your colleagues for refreshments and the opportunity to visit the exhibits.

All paid registrants and exhibitors will receive two tickets at the time of registration which may be redeemed for beer or wine at the Conference Reception. You must present a ticket in order to be served alcohol. Please be sure to bring these tickets with you to the reception. Nonalcoholic beverages do not require tickets.

MEETING DEADLINES

August 31: Housing forms due to the Dallas Housing Bureau (Do not send to OSA)

September 1: Preregistration forms due at OSA, including short course registration

September 23: Audio-visual special requests due to OSA

September 23: Deadline for OSA Annual Meeting and ILS Postdeadline papers to be received at OSA Meetings Department

October 2: Deadline for hand-delivered OSA Annual Meeting and ILS postdeadline papers at Message Center in Loews Anatole Hotel by **2:00pm, Sunday, October 2**

ILS EVENTS

ILS POSTDEADLINE PAPERS

To give participants an opportunity to hear new and significant material in rapidly advancing areas of laser science, authors will be able to present results that have been obtained after the normal deadline for contributed papers. All laser researchers are encouraged to contribute a postdeadline paper to the ILS Conference. Papers are solicited particularly in the areas relating to the subjects covered in symposia.

Authors of postdeadline papers **must** submit the following:

a. a cover letter indicating the significance of the contribution

b. one sheet of paper with your title, authors, and a 50-word abstract

c. copyright form (see the form included in this program)

d. 10 copies of these materials

Postdeadline papers are to be submitted to the OSA Conference Services Department, attn: ILS Postdeadlines, 2010 Massachusetts Avenue, NW, Washington, DC 20036. Only those papers received at OSA by **Friday, September 23** or hand-delivered to the Message Center in the Loews Anatole Hotel by **2:00pm on Sunday, October 2** will be considered.

The Technical Program Committee will select the postdeadline papers in a committee meeting held on Monday, October 3. Only postdeadline papers judged to be truly excellent and compelling in their timeliness will be scheduled as oral presentations on Thursday, October 6, or may be placed at the end of the related sessions of contributed papers. All others will be scheduled as posters for the Thursday poster session.

After postdeadline papers have been selected, a schedule will be printed and posted on the message board located in the Slide Preview Room and in the registration area. The selection and scheduling of postdeadline papers will be made with the interests of meeting participants given principal consideration.

Postdeadine papers, accepted for presentation, will be published in the following manner:

- Paper titles posted on the message board located in the Slide Preview Room and the registration area with session information (day and time).
- The 50 word summaries of the paper will be photo-offset and will be distributed to attendees prior to the Thursday postdeadline paper session.

Papers not accepted for the oral postdeadline paper session will be automatically scheduled as poster papers on Wednesday, October 5, unless otherwise directed by the corresponding author.

ILS BANQUET

The ILS conference banquet will be held Tuesday, October 4 in the Chantilly West Ballroom of the Loews Anatole Hotel. A social hour will begin with a cash bar at 6:30pm, and the banquet will begin at 7:30pm. The cost for the banquet will be $35. In order to ensure space, tickets must be ordered with the preregistration form no later than September 1, 1994.

The dinner will feature a plenary presentation by William Harris of the National Science Foundation.

ILS PLENARY LECTURES

Monday, October 3, 1994

MY1 11:30am–12:30pm
Chemical Dynamics Seen through the Vibration
Robin M. Hochstrasser
University of Pennsylvania

Tuesday, October 4, 1994

TuA1 8:00am–9:00am
Ultrashort-Pulse Lasers that Combine Versatility with Practicality, Wilson Sibbett
University of St. Andrews, United Kingdom

Wednesday, October 5, 1994

WS1 1:00pm–2:00pm
Applications of Optical Trapping to Single Molecule Experiments, Steven Chu
Stanford University

Thursday, October 6, 1994

ThA1 8:00am–9:00am
Molecular Hydrogen: Investigating the Spectroscopy, Decay Dynamics, and Reactions of the Excited States in the Age of the Laser, Patricia M. Dehmer
Argonne National Laboratory

ThDD1 1:00pm–2:00pm
Precision Spectroscopy of Hydrogen, Theodor W. Hansch
University of Munich, Germany

SCHAWLOW PRIZE

Steven Chu, *Stanford University*, will present the Schawlow Prize Address at the awards/plenary session on Tuesday, October 4, 1994, **4:00–4:45pm**. The talk is entitled **Laser Cooling and Trapping of Atoms**.

ANNUAL BUSINESS MEETING OF THE LASER SCIENCE TOPICAL GROUP

The Annual Business Meeting of the Laser Science Topical Group will be held Thursday, October 6, 8:00pm in **Grand A**, following the postdeadline paper session. All members and interested parties are invited to attend. The LSTG officers will report on the activities of the past year and on plans for the future. Questions will be taken from the floor. This is your chance to offer some input on the operations of the LSTG and the ILS Conference.

Partial Support for ILS-X from the Office of Naval Research, Coherent, Continuum, Lambda Physik, and Spectra Physics is gratefully acknowledged.

SHORT COURSES AT-A-GLANCE
Sunday, October 2, 1994

1:00pm-9:00pm	1:00pm-7:00pm	1:00pm-5:00pm
SC101 **Infrared Remote Sensing Instruments** Marija Scholl, *Alenka Associates*	**SC108** **Modern Optical Testing** James C. Wyant, *University of Arizona and WYKO Corporation*	**SC110** **Semiconductor Diode Lasers** Kam Lau, *University of California, Berkeley, and* C. Chang-Hasnain, *Stanford University*
SC102 **Adaptive Optics: Theory and Application** Glenn A. Tyler, *Optical Sciences Corporation*	**SC109** **Binary and Diffractive Optics: Design, Fabrication, and Applications** G. Michael Morris, *University of Rochester*	**SC111** **Vision Models in *Mathematica*** Andrew Watson, *NASA Ames Research Center*
SC103 **Topics in Image Formation** Douglas S. Goodman, *Polaroid*		**SC112** **Precision Mechanics** Erwin G. Loewen, *University of Rochester*
SC104 **Modern Coherence Theory** Emil Wolf, *University of Rochester*		
SC105 **Optical Design and Engineering** Robert E. Fischer, *Optics 1, Inc.*		
SC106 **Adaptive Wavelet Transforms** Harold Szu, *Naval Surface Weapons Center*		
SC107 **An Introduction to Nonlinear Optics** Robert A. Fisher, *RA Fisher Associates*		

Monday, October 3, 1994 1:00pm-5:00pm

Smart Pixels and their Applications to Analog Optical Processing
Kristina M. Johnson, *University of Colorado*

REGISTRATION FORM **OSA Annual Meeting/ILS-X • October 2 – 7, 1994 • Dallas, TX**

Section A: Badge Information

Last (Family) Name ID# ____________

First (Given) Name

Professional Affiliation/Institution

Department

Business Address (Mail Stop, Room, Laboratory, Center, Apt. #)

Street Address

City State Zip Code

Province Foreign Postal Code

Country

Telephone with Area Code FAX with Area Code

Telex

□ This is a new address. Please change all OSA records.

Mailing Information

Please return this form by air mail if mailed internationally to:

Optical Society of America/OSA/ILS '94
Meetings Department
2010 Massachusetts Avenue, N.W.
Washington, DC 20036
Tel: (202) 223-0920 Fax (202) 416-6100

To avoid duplicate charges, either mail or fax your registration form, NOT BOTH.

Payment Information

Please register only one person per form.
This form can be copied for additional registrants.
Registrants may pay by check, money order, bank draft, or credit card. **Checks and money orders must be payable to Optical Society of America in US dollars drawn on a US bank.** Your name and full address should be typed or printed clearly on your check. Acceptable credit cards include American Express, VISA, MasterCard, Diner's Club.

Method of Payment:
□ Check □ VISA
□ American Express □ Bank Draft
□ Money Order □ MasterCard
□ Diner's Club

Card issued in the Name of: ____________

Card Number ____________

Expiration Date ____________

I authorize Optical Society of America to charge the total payment fee indicated on this form to my credit card.

Signature ____________

Section B: Society Membership Information (check all that apply)

□ Acoustical Soc. of Am.
□ Am. Astronomical Soc.
□ Am. Ceramic Soc.
□ Am. Chemical Soc.
□ Am. Geophysical Union
□ Am. Physical Soc.
□ Am. Physical Soc./LSTG
□ Am. Soc. Laser Surgery & Med.
□ Am. Soc. Precision Eng.
□ Am. Vacuum Soc.
□ Assoc. Research Vision & Opth.
□ IEEE/LEOS
□ Lasers Inst. of Am.
□ Optical Soc. of Am.
□ Materials Research Soc.
□ SPIE
□ SPSE
□ Other
□ None of the Above

Section C: Registration Fees

The registration fee includes admission to all technical sessions, a copy of the *Bulletin of the American Physical Society,* a copy of the OSA Engineering How-to notes, admission to the conference wine and cheese reception, and all scheduled refreshment breaks.

	Before September 1, 1994	At the Meeting
MEMBERS: OSA/APS-LSTG (Regular)	1. □ US $275	□ US $325
STUDENTS/EMERITUS:	2. □ US $ 85	□ US $105
NONMEMBERS:	3. □ US $335	□ US $385

SECTION C PAYMENT $____________

Section D: One-Day Registration

This fee includes admission to the technical sessions, coffee breaks, and technical exhibit for one day, but DOES NOT INCLUDE admittance to the conference reception.

Before September 1, 1994	At the Meeting
4. □ US $160	□ US $190

Specify day (Check one):
50. □ Monday 10/3* 51. □ Tuesday 10/4 52. □ Wednesday 10/5 53. □ Thursday 10/6 54. □ Friday 10/7*
*no exhibit

SECTION D PAYMENT $____________

Section E: Short Courses

The Annual Meeting Short Course program consists of full day (8 hour) courses, 6-hour courses, and half day (4 hour) short courses. These courses are offered on Sunday, October 2 and Monday, October 3. The tuition rates to attend the short courses are as follows. (All rates quoted in US dollars):

	Before September 1, 1994	At the Meeting
Each Half-Day course	$110	$160
Each 6-hour course	$150	$190
Each Full-Day course	$190	$240

SUNDAY
□ SC101** □ SC103** □ SC105** □ SC107** □ SC109* □ SC111 **denotes 8 hour course
□ SC102** □ SC104** □ SC106** □ SC108* □ SC110 □ SC112 *denotes 6 hour course
MONDAY
□ SC113

SECTION D PAYMENT $____________

Section F: Additional Events

201. ILS BANQUET — Tuesday night Banquet $35.00
202. GUEST REGISTRATION — for Wednesday night Conference Wine & Cheese Reception (cash bar available)

Guest Name ____________

SECTION F PAYMENT $____________

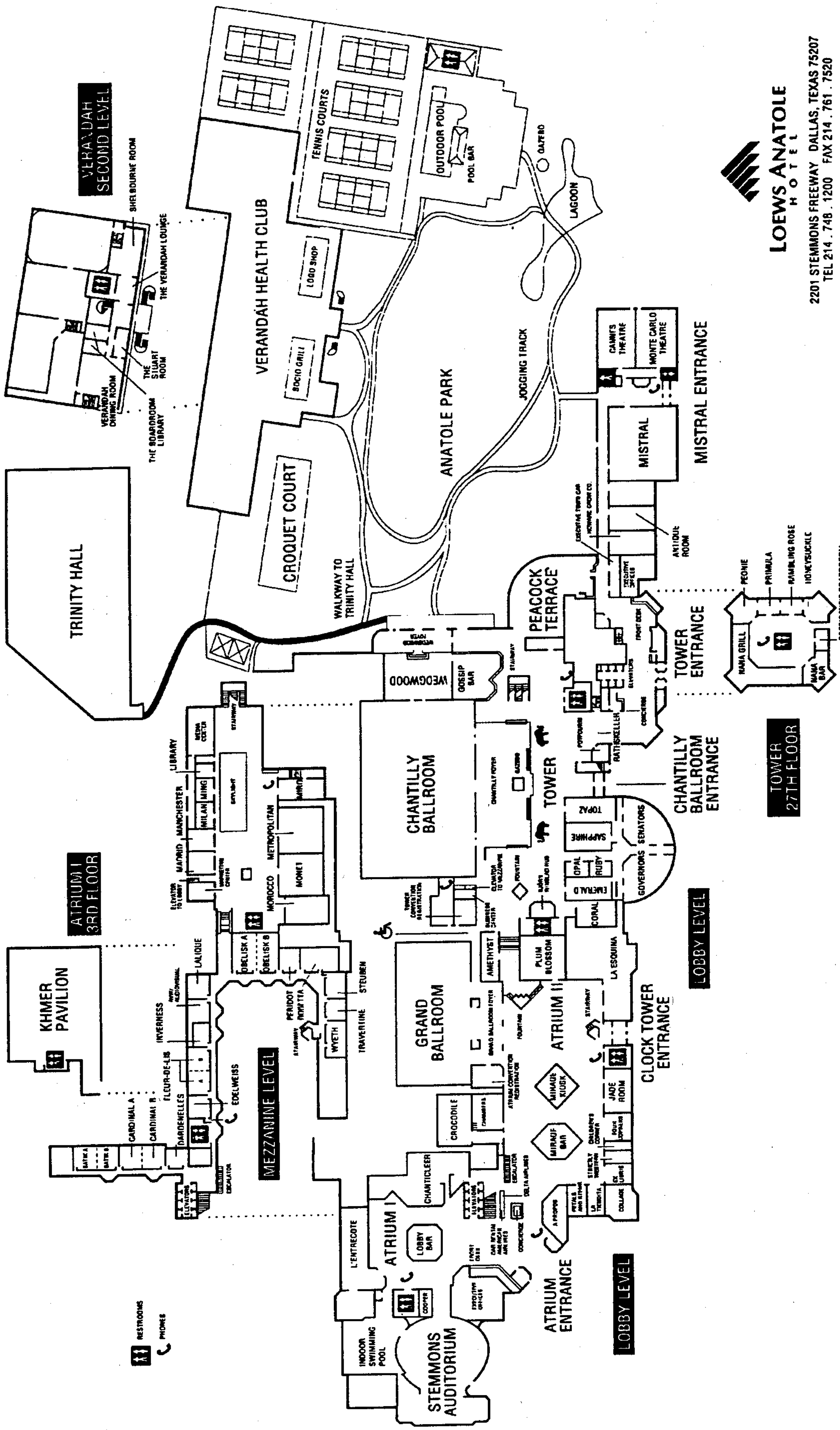
TOTAL PAYMENT $____________

OFFICIAL USE ONLY

Check No. ________ Check Date ________ Charge: AMEX/VISA/MC/DINER'S Amount Received ________
OSA Account # ________ Date ________ Batch ________ OSA ID ________

Refund policy for preregistration: There will be a $35 service charge for processing refunds. A letter requesting the refund should state the preregistrant's name and to whom the check should be made payable. Requests for preregistration refunds that are received no later than seven working days prior to the first day of the meeting will be honored. NO REFUNDS WILL BE CONSIDERED AFTER SEPTEMBER 22, 1994. No refund checks will be issued until after the meeting.

LOEWS ANATOLE HOTEL



DALLAS CONVENTION & VISITOR CENTER — OFFICIAL HOUSING FORM

Participating Hotels (Map on the back of form)

Loews Anatole Hotel	$108 (single)	$118 (double)
	$80 (interior rooms, no outside windows)	
Stouffer Dallas Hotel	$105 (single)	$115 (double)
Courtyard by Marriott—Market Center	$89 (single)	$109 (double)
Holiday Inn—Market Center	$67 (single)	$77 (double)

Housing Deadline: August 31, 1994

Please request additional rooms on a separate copy of this form. Send confirmation to:

Name ______________________________

Name of Company or Firm ______________________________

Street Address or P.O. Box Number ______________________________

City, State (Country), Zip Code ______________________________

Office Phone ______________ Home Phone ______________ Fax ______________

Arrival Date ______________ **Departure Date** ______________

Hotel Preference: 1st Choice ______________

2nd Choice ______________

3rd Choice ______________

Room Type: ☐ Single (1 person, 1 bed) ☐ Double (2 persons, 1 bed) ☐ Dbl-Dbl (2–4 ppl, 2 beds)

☐ Non-smoking ☐ Handicapped Accessible Room

Occupant's Name ______________ Share with ______________

____

____

Credit Card # ______________ Expiration Date ________ Cardholder's Name ______________ PRINT

Cardholder's Signature ______________

☐ American Express ☐ MasterCard ☐ Discover ☐ Visa ☐ Diners Club ☐ Carte Blanche

☐ Check ☐ Money Order

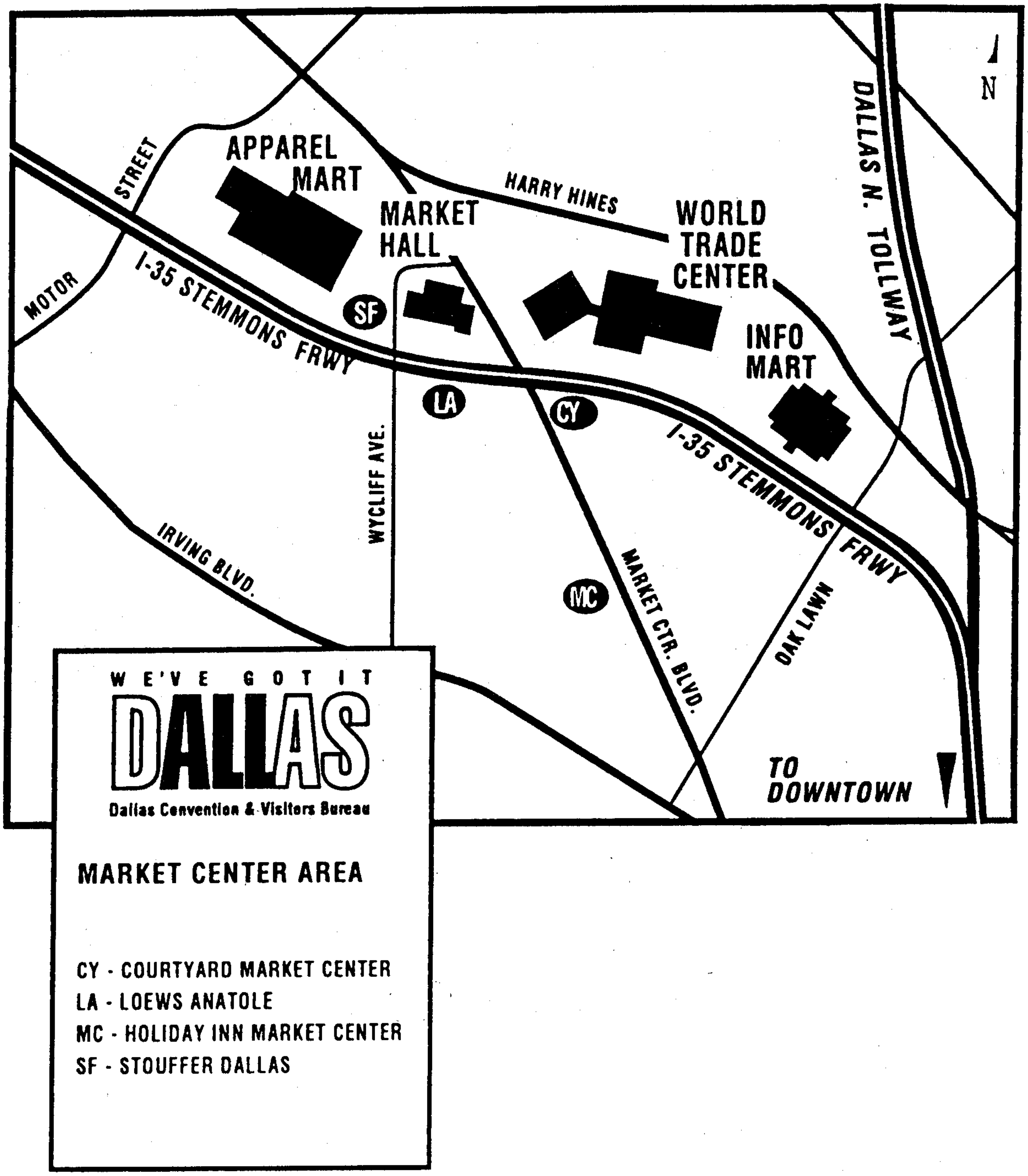
Deposit Required for All Confirmations on This Form:
The cardholder will be liable for deposit amount ($100 per room—applied toward your hotel folio) at time of processing, through the Dallas Convention & Visitors Housing Bureau. Deposit refundable through bureau prior to reservation cut-off date. After cut-off date, contact hotel. Deposits become non-refundable within 72 hours of scheduled arrival date.

Make checks payable to: **Dallas Housing Bureau**
1201 Elm Street, Suite 2000
Dallas, Texas 75270

Fax reservations FOR INTERNATIONAL USE ONLY: (214) 746-6693

MARKET CENTER AREA

October 2–7, 1994



INSTRUCTIONS FOR OSA AND ILS POSTDEADLINE PAPERS

1. When submitting a postdeadline paper to either OSA or ILS please provide the following information on ONE sheet of paper:
   - Authors and affiliations
   - 50-word abstract
2. In a cover letter, indicate if submission is for OSA or ILS postdeadline paper session, and for which technical area it is intended, explain the significance of the contribution, and why late submission was required.
3. Complete the copyright form (below).
4. Submit 10 copies of the materials.
5. Please complete and return the required materials to: OSA Conference Services, 2010 Massachusetts Avenue, NW, Washington, DC 20036-1023, by September 23, 1994, OR hand carry to the Message Center in the Loews Anatole Hotel by 2:00 pm on Sunday, October 2, 1994.

Optical Society of America 1994 Copyright Agreement

Program: OSA Annual Meeting/ILS–X *(circle one)*

Title of Article: ______________________________

Author(s): ______________________________

The undersigned hereby assigns to the Optical Society of America (the "Society") copyright ownership in the above-titled article to be effective as of the date published in the above-mentioned technical digest and to the extent transferable under applicable national law. It each author's signature does not appear below, then the signing author(s) represent that they sign this agreement as authorized agent(s) for and on the behalf of all the authors.

The Society shall have the right to register copyright in its name asclaimant. Also, the Society shall have the right to grant reprint permission to third parties and to negotiate and receive reasonable royalties in such instances.

Authors (or their employers, in the case of works made for hire) reserve all other rights to the above article including: (a) The right to use the work in future works of their own; (b) All proprietary rights other than copyright; (c) The right of the employer to make copies of the work. If prepared under a U.S. Government contract, the government shall have the rights under the copyright to the extent required by the contract.

Signature	*Signature*	*Signature*
Print Name	*Print Name*	*Print Name*
Title and Date	*Title and Date*	*Title and Date*

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EPITOME OF THE 1994 INTERDISCIPLINARY LASER SCIENCE CONFERENCE (ILS-X)

Please note that all rooms listed are located in the Loews Anatole Hotel (see floor plan on page XXX). Due to technical differences between the ways the OSA and the American Physical Society prepare and print their programs, please be aware of different numbering systems. The OSA scheme is shown in brackets- [ ]- in both the Epitome and Main Text. The ILS-X program is included in the OSA program necessitating the two different schemes.

The APS format for this years's meeting is as follows:

Session starting times, except as otherwise noted, are 8:30 and 10:30 (morning), 13:30 and 15:30 (afternoon).

A prime (') notation indicates an irregular starting time.

Each session is designated with an alpha-numeric. The letter indicates the scheduled day and time for that session, and the number indicates the room where the session will take place. For example, A designates Monday morning at 8:30am; J is on Wednesday at 15:30; etc. The number identifies the room assignment for a particular session, according to the following scheme:

MEETING	ROOMS:
1	Senators Lecture Hall
2	Topaz
3	Sapphire
4	Wedgwood
5	Grand D
6	Governors Lecture Hall
7	Grand B
8	Chantilly East
9	Chantilly West
10	Trinity Hall

MONDAY MORNING, 3 OCTOBER 1994

8:30 [ME]	**A1**	Symposium on Coherent Phenomena in Chemistry and Physics 1: Coherent Control in Chemistry. Senators Lecture Hall.
[MF]	**A2**	Symposium on Physics of Semiconductor Vertical Cavity Surface Emitting Lasers: 1. Topaz.
[MG]	**A3**	Joint Symposium on Photorefractive Polymers. Sapphire.
[MH]	**A4**	Symposium on Time-Resolved Infrared Spectroscopy 1: Condensed Phase Dynamics. Wedgwood.
10:30 [MQ]	**B1**	Symposium on Coherent Phenomena in Chemistry and Physics: Coherent State Preparation: 1. Senators Lecture Hall.
[MR]	**B3**	Symposium on Optical Induced Coherences in Semiconductors: 1. Sapphire.
[MS]	**B4**	Symposium on Time-Resolved Infrared Spectroscopy: 2. Wedgwood.
11:30 [MY]	**PL41**	ILS Plenary: 1. Wedgwood.

MONDAY AFTERNOON, 3 OCTOBER 1994

13:00 [MZ]	**C'5**	Joint Symposium on Advanced Optical Techniques for Medical

		Diagnostics: Imaging. Grand D.
13:30 [MEE]	C6	Symposium on Time-Resolved Infrared Spectroscopy 3: Gas Phase Dynamics. Governors Lecture Hall.
[MFF]	C1	Symposium on Coherent Phenomena in Chemistry and Physics: Coherent State Preparation: 2. (Senators Lecture Hall)
[MGG]	C2	Symposium on Physics of Semiconductor Vertical Cavity Surface-Emitting Lasers: 2. (Topaz)
[MHH]	C3	Symposium on Ultrafast Probes with Extremely High Spatial Resolution. (Sapphire)
16:00 [MTT]	D'6	Joint Symposium on Spectroscopic Applications for Environmental Studies: Laser Diagnostics for Hazardous Emissions Monitoring: 1. (Governors Lecture Hall)
[MUU]	D'1	Symposium on Coherent Phenomena in Chemistry and Physics: Coherent Control in Chemistry: 2. (Senators Lecture Hall)
[MVV]	D'2	Joint Symposium on New Wavelength Solid State Lasers. (Topaz)
[MWW]	D'3	Symposium on Optical Induced Coherences in Semiconductors: 2. (Sapphire)
[MXX]	D'4	Symposium on Strong Fields in Nonlinear Optics. (Wedgwood)

TUESDAY MORNING, 4 OCTOBER 1994

8:00 [TuA]	PL7	ILS Plenary: 2. Grand B.
8:30 [TuG]	E4	Joint Symposium on Advanced Optical Techniques for Medical Diagnostics: Spectroscopy 1. Wedgwood.
9:00 [TuL]	E'1	Joint Symposium on Ultrafast Laser Sources. Senators Lecture Hall.
10:30 [TuU]	F1	Joint Symposium on Spectroscopic Applications for Environmental Studies: Laser Diagnostics for Hazardous Emissions Monitoring: 2. Senators Lecture Hall.
[TuV]	F2	Joint Symposium on Ultrashort Pulse Solid State Lasers: 1. Topaz.
[TuW]	F3	Physics of Solid State Sources and Materials. Sapphire.
[TuX]	F4	Symposium on Advanced Optical Techniques for Medical Diagnostics: Spectroscopy 2. Wedgwood.

TUESDAY AFTERNOON, 4 OCTOBER 1994

13:30 [TuDD]	G8	Awards and Plenary Session. Chantilly East.
17:30 [TuFF]	G'10	ILS Poster Session: 1. Trinity Hall.
18:30 [TuGG]	PL9	ILS Banquet. Chantilly West.

WEDNESDAY MORNING, 5 OCTOBER 1994

8:00 [WB]	H'5	Joint Symposium on Luminescence in Widegap Semiconductive Media. Grand D.
8:30 [WG]	H1	Symposium on Coherent Phenomena in Chemistry and Physics: Coherent Control. Senators Lecture Hall.
[WH]	H2	Joint Symposium on Ultrashort Pulse Solid State Lasers: 2. Topaz.
[WI]	H3	Joint Symposium on Spectroscopic Applications for Environmental Studies: Atmospheric Trace Gases and Industrial Applications. Sapphire.

WEDNESDAY AFTERNOON, 5 OCTOBER 1994

13:00 [WS]	PL43	ILS Plenary: 3. Wedgwood.
14:00 [WCC]	I'1	Joint Symposium on Coherent Phenomena in Chemistry and Physics: Applications of Pulse Shaping Technology. Senators Lecture Hall.
[WDD]	I'2	Symposium on Particle Beam-Pumped Lasers. Topaz.
[WEE]	I'3	Joint Symposium on Spectroscopic Applications for Environmental Studies: Use of Lidar for Atmospheric and Environmental Measurements: 1. Sapphire.
[WFF]	I'4	Symposium on Optical Tweezers. Wedgwood.
15:30 [WMM]	J1	Joint Symposium on Shaping and Processing of Ultrashort Optical Pulses. Senators Lecture Hall.
[WNN]	J2	Joint Symposium on Ultrashort Pulse Fiber Lasers. Topaz.
[WOO]	J3	Joint Symposium on Spectroscopic Applications for Environmental Studies: Use of Lidar for Atmospheric and Environ-

		mental Measurements: 2. Sapphire.
[WPP]	J4	Joint Symposium on Manipulation of Atoms by Light: Trapping and Cooling. Wedgwood.
17:30 [WXX]	K'10	ILS Poster Session: 2. Trinity Hall.

THURSDAY MORNING, 6 OCTOBER 1994

8:00 [ThA]	PL44	ILS Plenary: 4. Wedgwood.
9:00 [ThN]	L'3	Symposium on Small Molecule Spectroscopy. Sapphire.
[ThO]	L'4	Joint Symposium on Manipulation of Atoms with Light: Nanokelvin Cooling: 1. Wedgwood.
10:30 [ThU]	M1	Joint Symposium on Subcritical High Intensity Laser-Plasma Interactions. Senators Lecture Hall.
[ThV]	M2	Joint Symposium on Ultrafast Diode Laser Sources: 1. Topaz.
[ThW]	M3	Joint Symposium on Novel Laser Techniques for Cluster Spectroscopy: 1. Sapphire.
[ThX]	M4	Joint Symposium on Manipulation of Atoms by Light: Nanokelvin Cooling: 2. Wedgwood.

THURSDAY AFTERNOON, 6 OCTOBER 1994

13:00 [ThDD]	PL45	ILS Plenary: 5. Wedgwood.
13:30 [ThKK]	N1	Joint Symposium on Solid-Density Laser-Matter Physics: 1. Senators Lecture Hall.
14:00 [ThQQ]	O'2	Joint Symposium on Ultrafast Diode Laser Sources: 2. Topaz.
[ThRR]	O'3	Joint Symposium on Novel Laser Techniques for Cluster Spectroscopy: 2. Sapphire.
[ThSS]	O'4	Joint Symposium on Manipulation of Atoms with Light: Atom Optics and Interferometry: 1. Wedgwood.
15:30 [ThXX]	P1	Joint Symposium on Solid Density Laser-Matter Physics: 2. Senators Lecture Hall.
[ThYY]	P2	Joint Symposium on Applications of Laser Materials Processing. Topaz.
[ThZZ]	P3	Joint Symposium on Novel Laser Techniques for Cluster Spectroscopy: 3. Sapphire.
[ThAAA]	P4	Joint Symposium on Manipulation of Atoms with Light: Atom Optics and Interferometry: 2. Wedgwood.
18:30	P'11	ILS Postdeadline Papers.

FRIDAY MORNING, 7 OCTOBER 1994

8:30 [FD]	Q6	Joint Symposium on Manipulation of Atoms by Light: Cold Collisions: 1. Governors Lecture Hall.
[FE]	Q1	Joint Symposium on High Field Laser-Matter Physics: Atoms and Molecules: 1. Senators Lecture Hall.
[FF]	Q3	Joint Symposium on High-Resolution Time-Domain Spectroscopy. Sapphire.
9:00 [FK]	Q'2	Joint Symposium on Single Molecule Spectroscopy: 1. Topaz.
10:30 [FP]	R6	Joint Symposium on Manipulation of Atoms by Light: Cold Collisions: 2. Governors Lecture Hall.
[FQ]	R1	Joint Symposium on High Field Laser-Matter Physics Atoms and Molecules: 2. Senators Lecture Hall.
[FR]	R2	Joint Symposium on Single Molecule Spectroscopy: 2. Topaz.
[FS]	R3	Linear and Nonlinear Optical Properties and Materials. Sapphire.

MAIN TEXT

SESSION A1 [ME]: SYMPOSIUM ON COHERENT PHENOMENA IN CHEMISTRY AND PHYSICS: 1: COHERENT CONTROL IN CHEMISTRY
Monday morning, 3 October 1994
Loews Anatole Hotel
Senators Lecture Hall at 8:30
Moshe Shapiro, presiding

8:30

A1 1 ME1 (Invited) **Controlling the future of matter,** Kent R. Wilson, *Department of Chemistry, University of California, San Diego, La Jolla, CA 92093-0339. E-mail: krwilson@ucsd.edu.* Quantum control of molecular dynamics is now moving from theoretical possibility to experimental reality. Theory, calculations, and computer animations of the control of nuclear motion in molecules and electronic motion in atoms are presented. Experimental confirmation of the theoretical predictions is demonstrated via the control of wavepacket evolution in I_2.

9:00

A1 2 ME2 (Invited) **Control of molecular photoionization,** Yi-Yian Yin,* Rana Shehadeh, Daniel Elliott,* Edward Grant, *Department of Chemistry, Purdue University, West Lafayette, IN 47907. Internet: egrant@chem.purdue.edu.* Recent results pertaining to the coherent control of photoelectron angular distributions through interfering one- and two-photon photoionization of the molecule NO are presented. Individual rotational states are isolated for ionization by a preceding step of $A^2\Sigma^+$ $X^2\Pi$ photoselection. Issues concerned with laser-mode quality and the use of resonant intermediate states are considered in the light of their implications for control.
**School of Electrical Engineering.*

SESSION A2 [MF]: SYMPOSIUM ON PHYSICS OF SEMICONDUCTOR VERTICAL-CAVITY SURFACE-EMITTING LASERS: 1
Monday morning, 3 October 1994
Loews Anatole Hotel
Topaz Room at 8:30
Hyatt M. Gibbs, presiding

8:30

A2 1 MF1 (Invited) **Semiconductor quantum wire nanostructures in microcavity lasers,** Arturo Chavez-Pirson, H. Ando, H. Saito, H. Kanbe, *Nippon Telegraph and Telephone (NTT) Basic Research Laboratories, 3-1 Morinosato Wakamiya, Atsugi-shi, Kanagawa 243-01, Japan. Internet: chavez@wave.ntt.jp.* Quantum-wire microcavity lasers combine low-dimensional quantum-wire gain media with 3D optical confinement in a microcavity. Using GaAs fractional-layer superlattice (FLS) quantum wires, we have successfully demonstrated room-temperature lasing in this new structure.[1] The efficient coupling of material and cavity states into the lasing process will result in ultimately compact, extremely low-current threshold lasers capable of ultrafast polarization modulation.
1. A. Chavez-Pirson, H. Ando, H. Saito, and H. Kanbe, Appl. Phys. Lett., April 4 (1994).

9:00

A2 2 MF2 (Invited) **Coherent energy transfer in microcavity lasers,** Galina Khitrova, *Optical Sciences Center, University of Arizona, Tucson, AZ 85721. Bitnet: schadler@ccit.arizona.edu.* Coherent energy transfer gives rise to a new peak and dip in the probe-gain spectrum that move proportionally with the intracavity injected power, showing that stimulated emission and absorption significantly speed up the response. Lasing can occur at the new gain peak.

9:30

A2 3 MF3 **Exciton dynamics in microcavity semiconductor lasers,** Tu Zhang, Ned Tabatabaie, *Department of Electrical and Computer Engineering, University of Wisconsin-Madison, 1415 Johnson Drive, Madison, WI 53706. E-mail: zhang@landau.ece.wisc.edu.* Inside an optical microcavity, the radiative lifetime of excitons will drastically increase when the sharp exciton levels are detuned from the cavity resonant modes. The theoretical and experimental consequences of such lifetime enhancement and the potential for the formation of an exciton condensation state are discussed.

10:00

A2 4 MF4 **Dynamic behavior of a microcavity laser with external injection,** Lua Li, Timothy L. Lucas, John G. McInerney,* *Center for High Technology Materials, University of New Mexico, Albuquerque, NM 87131. E-mail: huali@chtm.eece.unm.edu.* A theoretical study is presented on dynamics in an electrically-pumped vertical-cavity surface-emitting laser with weakexternal injection. Transient process of injection locking is explored. The transient time is calculated as a function of injected power and frequency detuning. A variety of nonlinear phenomena outside the locking range is obtained and compared with some of our experimental results.
**University College Cork, Ireland.*

SESSION A3 [MG]: SYMPOSIUM ON PHOTOREFRACTIVE POLYMERS
Monday morning, 3 October 1994
Loews Anatole Hotel
Sapphire Room at 8:30
Nasser Peyghambarian, presiding

8:30

A3 1 MG1 (Invited) **Photorefractive polymers and their applications,** Gary C. Bjorklund, W. E. Moener, Scott M. Silence, John J. Stankus, *IBM Almaden Research Center, 650 Harry Road, San Jose, CA 95120.* Photorefractive polymers have the potential to provide a large area, low cost, mechanically robust alternative to inorganic photorefractive crystals. Recent progress in the development of photorefractive polymer materials is summarized and prospects for applications in holographic data storage, optical processing, and optical power limiting are discussed.

9:00

A3 2 MG2 (Invited) **A new highly-efficient PVK-based photorefractive polymer,** K. Meerholz, B. Volodin, Sandalphon, B. Kippelen,* N. Peyghambarian, *Optical Sciences Center, University of Arizona, Tucson, AZ 85721. E-mail: haribo@ccit.arizona.edu.* Photorefractive (PR) polymers are new materials with many possible photonic applications including dynamic holographic storage and image processing. We have developed a PR polymer composite with significantly enhanced performance in comparison with existing organic materials. For the first time, to our knowledge, an oscillatory behavior of the diffraction efficiency η in dependance of the applied electric field was observed in a 105-μm thin polymer film. The saturation value ($\eta = 86\%$) is close to unity, if 12% absorption of the sample is taken into account. The material also exhibits a net two-beam-coupling gain of 200 cm^{-1}.
**I.P.C.M.S., France.*

9:30

A3 3 MG3 (Invited) **Physics of photorefractive polymers,** Stephen Ducharme, Martin Liphardt, Arosha Goonesekera, Brian Jones, James M. Takacs,* Lei Zhang,* *Department of Physics and Astronomy, Center for Materials Research and Analysis, University of Nebraska, Lincoln, NE 68588-0111.* Two-beam energy-coupling, degenerate four-wave mixing, electro-optic, and photoconduction measurements reveal

many important details of the physics of photorefractive polymers such as the density and type(s) of charge traps, the contributions of drift and diffusion transport, and the quantum efficiency and mobility.
*Department of Chemistry.

SESSION A4 [MH]: SYMPOSIUM ON TIME-RESOLVED INFRARED SPECTROSCOPY 1:3 CONDENSED PHASE DYNAMICS
Monday morning, 3 October 1994
Loews Anatole Hotel
Wedgwood Room at 8:30
Phillipe Guyot-Sionnest, presiding

8:30
A4 1 MH1 (Invited) **Transient mid-IR spectroscopy in conjugated polymers**, Lewis J. Rothberg, *AT&T Bell Laboratories, Murray Hill, NJ 07974. E-mail: ljr@physics.att.com.* The rapidly expanding set of realized and potential applications for conjugated polymeric materials includes light-emitting diodes, thin-film transistors, and transparent conductors. Subpicosecond mid-IR spectroscopy of these quasi-one-dimensional organic semiconductors provides insight into the nature of the relevant photogenerated excitations in these polymers.

9:00
A4 2 MH2 **IR hole-burning in disordered ammonium salts**, Herbert L. Strauss, *Department of Chemistry, University of California, Berkeley, CA 94720. E-mail: hls@hafnium.cchem.berkeley.edu.* The N-D stretching bands of NH_3D^+ ions doped into disordered ammonium salts have been subject to hole-burning. The process involves the rotation of the ion and occurs in both ordered crystalline salts and disordered salts and polymers. This hole-burning technique has been used to follow the relaxation of the vibration and the kinetics of the reorientation.

9:30
A4 3 MH3 **Broadband IR studies of ultrafast metal-carbonyl photochemistry**, Edwin J. Heilweil, Thomas P. Dougherty, W. Tandy Grubbs, *Molecular Physics Division, Physics Laboratory, B268 Building 221, National Institute of Standards and Technology, Gaithersburg, MD 20899-0001. Internet: ejh@tiber.nist.gov.* A transient IR method incorporating solid-state broadband IR down/upconversion with 400-fs time resolution is described.[1] IR reference and probe CCD tracks are divided on each shot to yield transient difference absorption spectra (8000 shots at 20 Hz, 4 cm^{-1} resolution, 120 cm^{-1} wide, baseline $\Delta OD=0.001(1\sigma)$) without laser/crystal tuning. Time-resolved photolysis spectra of $M(CO)_6$ (M=Cr,Mo,W), $[CpFe(CO)_2]_2$ ($Cp=\eta^5\text{-}C_5H_5$), $Cp^*Ir(CO)_2$($Cp^*=\eta^5\text{-}C_5(CH_3)_5$ and $CpCo(CO)_2$ in n-hexane at 298 K is discussed.[2]
1. Thomas P. Dougherty and Edwin J. Heilweil, *A Dual Beam Subpicosecond Broadband Infrared Spectrometer*, Optics Letters, **19**, 129 (1994).
2. Thomas P. Dougherty and Edwin J. Heilweil, *Transient IR Spectroscopy of (η^5-C_5H_5)$Co(CO)_2$ Photoproduct Reactions in Hydrocarbon Solutions*, J. Chem. Phys., **100**, 4006 (1994).

10:00
A4 4 MH4 **Vibrational dynamics of hydrogen atoms on silicon surfaces**, Phillipe Guyot-Sionnest, Pao-Hung Lin, *James Franck Institute, University of Chicago, 5640 S. Ellis Avenue, Chicago, IL 60637.* UHV prepared Si(100)/H surfaces show a much slower lifetime for the Si-H stretching vibration than the previously studied Si(111)/H. Temperature dependance and two-color experiments are used to probe the relaxation mechanism.

SESSION B1 [MQ]: SYMPOSIUM ON COHERENT PHENOMENA IN CHEMISTRY AND PHYSICS COHERENT STATE PREPARATION: 1
Monday morning, 3 October 1994
Loews Anatole Hole
Senators Lecture Hall at 10:30
Robert J. Gordon, presiding

10:30
B1 1 MQ1 (Invited) **State selection using frequency-swept laser pulses**, Joseph S. Melinger, Warren S. Warren,* *Naval Research Laboratory, Code 6613, Washington, DC 20375. E-mail: Melinger@radef.nrl.navy.mil.* New experimental approaches for the generation of ultrashort frequency and amplitude-modulated laser pulses in both the visible and IR parts of the spectrum are discussed. We also show how such modulated laser pulses, when of sufficient intensity to exceed the weak-response limit, yield enhanced population transfer in molecular systems.
**Princeton University.*

11:00
B1 2 MQ2 (Invited) **Coherent preparation of vibrational levels with cw and pulsed lasers: recent progress and new experiments**, Klaas Bergmann, *Fachbereich Physik der Universität, 67653 Kaiserslautern, Germany. Internet: bergmann@sun.rhrk.uni-kl.de.* The preparation of molecules in high-vibrational levels, and some related collision dynamics studies, are discussed. Specifically, preparation of NO(v), v>>1, with pulsed lasers, reactive collisions of $Na_2(v)$ molecules with C1, the process of dissociative attachment of low-energy electrons to $Na_2(v)$, with 0<v<30 in both cases, and applications in spectroscopy.

SESSION B3 [MR]: SYMPOSIUM ON OPTICAL-INDUCED COHERENCES IN SEMICONDUCTORS: 1
Monday morning, 3 October 1994
Loews Anatole Hotel
Sapphire Room at 10:30
Duncan Steel, presiding

10:30
B3 1 MR1 (Invited) **Polarization-dependent coherent spectroscopy of excitons in quantum wells**, J. Kuhl, E. J. Mayer, G. O. Smith, D. Bennhardt,* T. Meier,* A. Schulze,* P. Thomas,* R. Hey,** K. Ploog,** *Max-Planck-Institut für Festkörperforschung, Heisenbergstr. 1, 70569 Stuttgart, Germany. E-mail: KUHL@servix.mpi-stuttgart.mpg.de.* The polarization dependence of time-integrated and temporally- as well as spectrally-resolved degenerate four-wave mixing demonstrates the strong influence of exciton/exciton interaction on the nonlinear optical response of 2D excitons. Comparison of experimental data with a phenomenological theoretical model permits distinction of contributions orginating from biexcitons and unbound two-exciton states.
**S. W. Koch Philipps University, Germany. **Paul-Drude Institut für Festkörperelektronik, Germany.*

11:00
B3 2 MR2 (Invited) **Nonlinear optical response from excitation-induced dephasing and biexcitons in GaAs**, Hailin Wang, K. B. Ferrio,* D. G. Steel,* Jagdeep Shah, T. C. Damen, L. N. Pfeiffer, *AT&T Bell Laboratories, 101 Crawfords Corner Road, Holmdel, NJ 07733. E-mail: hailin@spin.att.com.* Transient nonlinear optical measurements using differential absorption and four-wave mixing show important contributions from excitation-induced dephasing in bulk GaAs and from biexcitonic effects in GaAs quantum wells. The distinct polarization dependence of these nonlinear responses is discussed.
**University of Michigan.*

SESSION B4 [MS]: SYMPOSIUM ON TIME-RESOLVED INFRARED SPECTROSCOPY: 2
Monday morning, 3 October 1994
Loews Anatole Hotel
Wedgwood Room at 10:30
James Muckerman, presiding

10:30
B4 1 MS1 **(Invited) Generation and detection of fsec pulses of THz radiation,** D. Grischkowsky, N. Katzenellenbogen, *Oklahoma State University, 200 Eng. S, Stillwater, OK 74048.* A unique opto-electronic THz beam system is described. The system can generate and detect fsec pulses of freely-propagating THz radiation with a demonstrated time-resolution of better than 80 fsec and a signal-to-noise ratio of more than 1000. Some applications of this system are presented to illustrate its generality and usefulness.

11:00
B4 2 MS2 **(Invited) Tunable IR picosecond pulses from 1.2 to 13 μm by parametric amplification,** Winfried Daum, *Institut für Grenzflächenforschung und Vakuumphysik, Forschungszentrum Jülich, D-52425 Jülich, Germany. Internet: w.daum@kfa-juelich.de.* Optical parametric amplification (or difference frequency generation) is a useful way to produce widely-tunable, intense mid-IR picosecond pulses for various applications. Using $AgGaS_2$ crystals a tuning range from 1.16 to 13μm with photon conversion efficiencies of more than 20% can be achieved. Extensions to larger wavelengths are discussed.

SESSION PL41 [MY]
ILS PLENARY: 1
Monday morning, 3 October 1994
Loews Anatole Hotel
Wedgwood Room at 11:30
Marsha Lester, presiding

11:30
PL4 1 MY1 **(Plenary) Chemical dynamics seen through the vibrations,** Robin M. Hochstrasser, *Department of Chemistry, University of Pennsylvania, Philadelphia, PA 19104.* Transient IR methods have now reached the 40 fs time regime. The use of techniques which bring out vibrational properties is showing that solution-phase reactions are profoundly different from their gas counterparts in a number of cases. In addition, the occurrence of vibrational coherence transfer and creation in chemical reactions is providing a new handle on condensed phase processes. A number of reactions which evidence these effects and show novel transition-state phenomena occurring in solutions, are discussed.

BREAK

SESSION C'5 [MZ]: SYMPOSIUM ON ADVANCED OPTICAL TECHNIQUES FOR MEDICAL DIAGNOSTICS: IMAGING
Monday afternoon, 3 October 1994
Loews Anatole Hotel
Grand D Room at 13:00
Robert R. Alfano, presiding

13:00
C'5 1 MZ1 **(Invited) Resolution in optical imaging of turbid biological tissues *in vivo*,** M. J. Yadlowsky, J. M. Schmitt, A. Gandjbakhche, R. F. Bonner, *National Institutes of Health, BEIP/NCRR, Building 13, Room 3W13, Bethesda, MD 20892.* Biological tissues exhibit strong, anisotropic scattering which limits resolution of *in vivo* imaging. We analyzed the degradation of coherence of light propagating within highly scattering tissues and determined the associated practical resolution limits for increasing depths *in vivo* of microscopies utilizing confocal and low-coherence interferometric techniques. Resolution in time-gated transmission inaging of thick organs is shown to be limited by the minimal excess transit time practically attainable for a given optical thickness.

13:30
C'5 2 MZ2 **(Invited) Spectroscopy and imaging of brain and breast with diffusive light waves,** B. Chance, A. Yodh,* M. O'Leary,* D. Boas,* *Department of Biochemistry and Biophysics, University of Pennsylvania, Philadelphia, PA.* The better understanding of the propagation diffusive phonton density waves in highly scattering materials such as brain or breast allows the identification of the optical and spatial properties of hidden inhomogeneities (within 1 cm or better). Object localization is further simplified by the use of multiple, phased sources and contrast agents at subnanomole amounts in volumes of <50 mg.
**Department of Physics,*

14:00
C'5 3 MZ3 **(Invited) Time-resolved NIR study of pulse propagation and imaging in tissues for optical mammography,** Feng Liu, B. B. Das, R. R. Alfano,* *Department of Electrical Engineering, New York State Center for Advanced Technology for Ultrafast Photonic Materials and Applications, Institute of Ultrafast Spectroscopy and Lasers, Mediphotonics Laboratory, The City College of the City University of New York, New York, NY 10031. Internet: liu@scisun.sci.ccny.cuny.edu.* Transmitted photon intensity within various time windows was found to decay exponentially as thickness over the transport scattering length of the media. Near-IR light were found much less scattered in tissues. Thus imaging through thick tissue using NIR laser pulse is possible, making another step closer to optical mammography.
**Also with the Department of Physics.*

14:30
C'5 4 MZ4 **Effects of Fourier spatial filter on the temporal profiles of ultrashort laser pulses propagated through a turbid medium,** Q. Z. Wang, X. Liang, L. Wang, P. P. Ho, R. R. Alfano, *Institute for Ultrafast Spectroscopy and Lasers, New York State Center for Advanced Technology for Ultrafast Photonic Materials and Applications, Departments of Physics and Electrical Engineering, The City College and Graduate School of The City University of New York, Convent Avenue at 138th Street, New York, NY 10031. E-Mail:zhen@scisun.ccny.cuny.edu.* The temporal profiles of ultrashort laser pulses propagated through a turbid medium were measured with a streak camera. A Fourier spatial filter was applied to select the spatial frequencies of the scattered laser pulses. The temporal profile of the scattered laser pulse was significantly narrowed with the Fourier spatial filter.

14:45
C'5 5 MZ5 **Frequency domain detection and localization of heterogeneities in tissue-like media,** Jeffrey Reynolds, Simon Yeung, Andreas Przadka, James Walters, Keven Webb, Neal Gallagher, *School of Electrical Engineering, Purdue University, West Lafayette, IN 47907-1285. E-mail: jreynold@ecr.purdue.edu.* Frequency domain diffusion wave measurements are made on tissue-like scattering media with heterogeneities. These experimental results are compared with simulations obtained with a Fourier-transformed finite-difference time-domain solution of the diffusion equation. The effect of measurement configuration and sample characteristics on resolution and sensitivity are studied.

SESSION C6 [MEE]: SYMPOSIUM ON TIME-RESOLVED INFRARED SPECTROSCOPY: 3 GAS PHASE DYNAMICS

Monday afternoon, 3 October 1994
Loews Anatole Hotel
Governors Lecture Hall at 13:30
Louis F. DiMauro, presiding

13:30

C6 1 . MEE1 (Invited) IR control of molecular dissociation, James T. Muckerman, *Chemistry Department, Brookhaven National Laboratory, Upton, NY 11973-5000. Internet: muckerma@bnl.gov.* The results of theoretical studies involving quantum wavepacket calculations of the dissociation dynamics of small molecules in the field of two or more overlapping short-pulsed lasers is presented. Optimal control studies of the five-color IR dissociation of a full-dimensionality model HF, and the two-color dissociation of a linear model of acetylene is interpreted mechanistically.

14:00

C6 2 MEE2 (Invited) Molecular dynamics through time-resolved ro-vibration spectroscopy, David S. King, *Molecular Physics Division, National Institute of Standards and Technology, Gaithersburg, MD 20899-0001. E-mail: king@enh.nist.gov.* Time-resolved measurements of ro-vibrational populations and state-resolved velocity distributions are used to support arguments concerning reaction pathways and mechanism. The unconstrained $O(^{1D}) + H_2O$ reaction and the O plus water reaction proceeding in a small complex where cooperative chemical effects are important, is considered.

14:30

C6 3 MEE3 (Invited) Kinetics and dynamics measurements on the reactions of translationally and vibrationally excited reagents by time-resolved FTIR spectroscopy, P.A. Berg, C.A. Carere, J.J. Sloan, *Department of Chemistry, University of Waterloo, Waterloo, Ontario, Canada N2L 3G1. Internet: sloanj@UWaterloo.CA.* Fourier transform spectroscopy with microsecond time resolution was used to observe IR emission from the products of transient reactions between hydrogen atoms and small molecules. The time resolution gives kinetic data, while the high spectral resolution (0.1 cm^{-1}) gives dynamical information via the detailed product energy partitioning.

15:00

C6 4 MEE4 Collision assisted spectroscopy of highly vibrationally-excited HCN, J. Spencer Baskin, Alain Saury, Edwin Carrasquillo M., *Department of Chemistry, University of Houston, Houston, TX 77204-5641. E-mail: chem5z@jetson,uh.edu.* We have utilized a new approach, based on collisional energy transfer, for spectroscopic study of HCN in the ground state at vibrational energies between 4,500-12,000 cm^{-1} and in the first-excited electronic state. The extensive rovibrational structure accessed is discussed.
Supported by the NSF, R.A. Welch Foundation, ISSO, Energy Laboratory and the Environmental Institute at the University of Houston.

15:15

C6 5 MEE5 IR-UV double-resonance study of NO(X, v''=3) vibrational energy transfer, Ingrid J. Wysong, *Hughes STX, PL/RKFA, Edwards AFB, CA 93534-7660. Internet: wysongi@scivx3.ple.af.mil.* The IR overtone pumping technique for preparing vibrationally-excited populations has been extended to the second overtone to study NO(X,v=3). Vibrational relaxation rate constants are then obtained using a laser-induced fluorescence (LIF) probe. State-specific vibrational-energy transfer rate constants have been obtained in several studies by using an IR laser to pump the first overtone transition (v=0 to v=2) and a UV laser to probe the time-dependent populations with LIF on the A-X electronic transition. This technique has been extended to pump v=3 of the NO molecule via the second overtone transition using tunable radiation at 1.8 μm. This transition is extremely weak, but sufficient signal can be obtained under favorable conditions. Relaxation rate constants have been measured for NO(X,v=3) colliding with NO, O_2, and CH_4. Results indicate that NO-NO V-V (vibration-to-vibration) transfer for low v is controlled by long-range attractive forces, as seen in CO-CO V-V transfer.

SESSION C1 [MFF]: SYMPOSIUM ON COHERENT PHENOMENA IN CHEMISTRY AND PHYSICS: COHERENT STATE PREPARATION: 2

Monday afternoon, 3 October 1994
Loews Anatole Hotel
Senators Lecture Hall at 13:30
Robert J. Gordon, presiding

13:30

C1 1 MFF1 (Invited) Coherent superposition states in large molecules, Peter M. Weber, *Department of Chemistry, Box H, Brown University, Providence, RI 02912. E-mail: Peter_Weber@brown.edu.* The nature of superposition states of molecules in very short-lived states can be manipulated by tuning the coherence parameters of the laser pulses used for the electronic excitation. Two-photon ionization photoelectron spectra reveal the composition of the prepared superposition states in terms of their zero-order-state contributions.

14:00

C1 2 MFF2 Orbital alignment in photo-dissociation products by two-color photoninterference, André D. Bandrauk, E. Aubanel, *Laboratoire de Chimie Théorique, Université de Sherbrooke, Quebec, J1K 2R1, Canada. Bitnet: kcya@udesvm.* Time-dependent coupled equations are used to examine simultaneous two-photon $(\omega_1+\omega_2)$ and three-photon $(3\omega_2)$ transitions into the dissociative Π_g and Π_u states of Cl_2 when $\omega_1 = 2\omega_2$, both transitions prepare states of equal energy but different symmetry. Introducing multiple rotational excitation allows for laser alignment of the molecules at high intensities as predicted before.[1] Varying the phase between the two-photon beams allows for the preparation of different linear combinations of Π_g and Π_u states. The results show an increasing electronic orbital alignment and asymmetrical angular distributions in the photofragments with increasing intensity of the two-photon beams.

1. A.D. Bandrauk, J.F. McCann, Phys. Rev. A42, 2806 (1990); J. Chem. Phys. 96, 903 (1992).

14:15

C1 3 MFF3 Determination of weak decay rates via coherent coupling to a strong transition, Aaron S. Manka, *Weapons Sciences Directorate, AMSMI-RD-WS-ST, Research, Development, and Engineering Center, U.S. Army Missile Command, Redstone Arsenal, AL 35898-5248. E-mail: drmordecai@aol.com.* A method to determine a slow decay rate by coupling the weak transition to a strong one is proposed. This coherent coupling allows for the indirect measurement of a weak decay rate by taking a fast-Fourier transform of the time dependent intensity oscillations of the strong transition.

14:30

C1 4 MFF4 Quantum control of wave-packet dynamics, Jeffrey L. Krause, Robert M. Whitnell, Kent R. Wilson, YiJing Yan, *Department of Chemistry, University of California, San Diego, La Jolla, CA 92093-0339. E-mail: krwilson@ucsd.edu.* Computational results on the control of electronic wave packets in atoms, and vibrational wave packets in molecules are presented. It is shown that transient nano- and picostructures can be created, and then detected by subsequent optical, x-ray, or electron pulses. Extensions to the strong respose regime are also discussed.

SESSION C2 [MGG]: SYMPOSIUM ON VERTICAL-CAVITY SURFACE-EMITTING LASERS: 2
Monday afternoon, 3 October 1994
Loews Anatole Hotel
Topaz Room at 13:30
Hyatt M. Gibb, presiding

13:30
C2 1 MGG1 (Invited) **Reliability of vertical-cavity surface-emitting lasers fabricated by proton implantation**, K. Tai, C. C. Wu, K. F. Huang, *Institute of Electro-Optical Engineering, Chiao Tung University, Hsinchu, Taiwan. E-mail: kct@cc.nctu.edu.tw.* Low-threshold current 0.85-μm lasers with a mean time-to-failure of $6x10^4$ hours were fabricated. Effect of proton energy on threshold current and reliability was studied on similarly fabricated 0.98-μm lasers. Gain-guided vertical-cavity lasers incorporating two distributed Bragg reflectors were fabricated. Typical threshold currents were 3.8 mA for 12-μm diameter 0.85-μm GaAs QW lasers and 5 mA for 20-μm diameter 0.98-μm strained InGaAs QW lasers. Mean time-to-failure of $6x10^4$ hours at 25º C and 15 mA operation condition with 2-3 mW output was determined by standard high temperature burn-in procedure performed on 58 randomly selected 0.85-μm devices. Experiments on 0.98-μm devices revealed the importance of implant energy in optimizing threshold current and lifetime. Lower thresholds were found at higher implant energies of 400 and 450 keV than at 350 keV. On the other hand at 450 keV lasers often suffered from sudden failure. Lower threshold was attributed to better current confinement for deeper implant and, the sudden failure, similarly, to the damage when implant actually reaches the active. After high current stress, dark lines appeared on the near-field luminescence pattern operating below threshold. This suggests the failure mechanism relates closely with growth of dislocation defects.

14:00
C2 2 MGG2 **Multilayer analysis of heat-flux spreading in vertical-cavity surface-emitting lasers with semiconducting Bragg mirrors**, Marek Osiski, Antonio Leal, W odzimierz Nakwaski,* *Center for High Technology Materials, University of New Mexico, Albuquerque, NM 87131-6081. E-mail: osinski@chtm.unm.edu.* Two-dimensional heat-flux spreading in multilayer structures of GaAs/AlGaAs/AlAs proton-implanted top-surface-emitting vertical-cavity diode lasers is investigated using a new, simple analytical method that allows for the first time, to our knowledge, consideration of multilayer aspects of heat conduction without requiring extensive numerical calculations. Optimal design conditions that minimize thermal resistance of the device are identified.
**Technical University of Lódz , Poland.*

14:15
C2 3 MGG3 **Double-disk structure for output coupling in microdisk lasers,** D. Y. Chu, S. L. Wu, S. T. Ho, M. K. Chin,* W. G. Bi,* H. Q. Hou,** C. W. Tu,** *Department of Electrical Engineering and Computer Science, The Technological Institute, Northwestern University, 2145 Sheridan Road, Evanston, IL 60208. E-mail: sth@eecs.nwu.edu.* An initial experiment on the use of a double-disk structure to couple light from microdisk lasers is reported. The fabrication technique and lasing characteristics of these lasers, including the increase in output emission and the narrowing phenomena of laser linewidth, are discussed.
**Nanyang Technological University, Republic of Singapore.*
***University of California, San Diego.*

14:30
C2 4 MGG4 **Output characteristics of optically-pumped vertical-cavity surface-emitting lasers in an electric field,** Xinqiao Wang, Steve D. Hersee, John G. McInerney,* Steve R. J. Brueck, *Center for High Technology Materials, University of New Mexico, Albuquerque, NM 87131. E-mail: xqwang@chtm.eece.unm.edu.* Reduction of threshold pumping power, improvements on the saturation level, and linerity of output-input curve have been observed in an optically-pumped vertical-cavity surface-emitting laser by applying an external electric field on the laser. Theoretical analysis indicates that the same effect can be achieved by employing a PIN structure in the laser cavity.
**University College Cork, Ireland.*

14:45
C2 5 MGG5 **Surface-emitting SHG based on intersubband transitions in *n*-type QWs,** Rui Q. Yang, *University of Toronto, 10 King's College Road, Toronto M5S 1A5 Canada. E-mail: yangrq@vrg.toronto.edu.* Noticing the difference of local responses to light in QWHs, it is demonstrated that the surface-emitting second-harmonic generation due to optical intersubband transitions in asymmetric conduction band quantum wells is possible.

15:00
C2 6 MGG6 **Dynamical behavior of a semiconductor laser with external cavity,** Yun Liu,* Junji Ohtsubo, *Faculty of Engineering, Shizuoka University, Johoku 3-5-1, Hamamatsu, 432 Japan. E-mail: ohtsubo@oeme.shizuoka.ac.jp.* A detailed theoretical analysis and numerical studies of the dynamics of GaAs/AlGaAs laser diodes with optical feedback of different levels have been performed. The dynamics of the external cavity laser is generalized as a simple delay-differential model and the mode analysis and numerical simulations are applied to investigate the stability and bifurcations.
**Graduate School of Electronic Science and Technology.*

SESSION C3 [MHH]: SYMPOSIUM ON ULTRAFAST PROBES WITH EXTREMELY HIGH SPATIAL RESOLUTION
Monday afternoon, 3 October 1994
Loews Anatole Hotel
Sapphire Room at 13:30
Ted. B. Norris, presiding

13:30
C3 1 MHH1 (Invited) **Picosecond high spatial resolution photoconductive probe development,** Steve Williamson, Juongo Kim, John Nees,* John Whitaker,* *Picometrix Laser & Electronic Instrumentation, Picometrix, Inc., P.O. Box 130243, Ann Arbor, MI 48113-0243.* The development of a contacting photoconductive probe having submicrometer spatial resolution and picosecond temporal resolution is discussed. The noninvasiveness of the probe and its immunity from rf pickup is also discussed.
**University of Michigan.*

14:00
C3 2 MHH2 (Invited) **Ultrafast scanning probe microscopy towards ultrafast movies of moving atoms,** S. Weiss, D. Botkin, D. F. Ogletree, M. Salmeron, D. S. Chemla, *Materials Sciences Division, Lawrence Berkeley Laboratory and Department of Physics, University of California at Berkeley, CA 94720. E-mail: sweiss@ux5.lbl.gov.* Simultaneous picosecond time and atomic space resolution measurements have been demonstrated with the ultrafast STM.[1] Room temperature quantum mechanical capacitance of the STM point contact have been observed for the first time to our knowledge. The potential for creating movies of surface dynamics on atomic scale, with atomic (ultrafast) time resolution is discussed.

1. S. Weiss, D. F. Ogletree, D. Botkin, M. Salmeron and D. S. Chemla, Appl. Phys. Lett., 63, 2567 (1993).

This work was supported by the Laboratory Directed Research and Development Program of Lawrence Berkeley, under the U.S. Department of Energy, contract DE-AC03-76SF00098 and by ONR/ARPA under contract #N000-14.93.105.36.

14:30
C3 3 MHH3 **Femtosecond near-field scanning optical microscope,** S. Smith, B. G. Orr, R. Kopelman,* T. Norris,** *Department of Physics, Center for Ultrafast Optical Science, 1006 IST Building, University of Michigan, Ann Arbor, MI 48109-2099. E-mail:ssmith @server.physics.lsa.umich.edu.* Efforts towards femtosecond time resolution combined with the nanometer spatial resolution of Near-field Scanning Optical Microscopy (NSOM) are described. A NSOM capable of performing highly localized (of order 100 nm) pump-probe measurements has been developed. The instrument, present cross correlations, and preliminary pump-probe results are described.
**Also with the Department of Chemistry. **Department of Electrical Engineering and Computer Science.*

14:45
C3 4 MHH4 **Time-resolved nonlinear near-field micro-scopy of semiconductor microdisks,** J. B. Stark, U. Mohideen, E. Betzig, R. E. Slusher, *AT&T Bell Laboratories, 600 Mountain Avenue, Murray Hill, NJ 07974. E-mail: jstark@physics.att.com.* We use 40-fs optical pulses and near-field microscopy techniques to image the nonlinear optical response of GaAs QWs in the plane of semiconductor microdisks with thickness near 100 nm and diameters from 2 to 10 μm. Carrier dynamics near the microdisk edge depend on the surface passivation used in processing these microstructures.

15:00
C3 5 MHH5 **Time-resolved photothermal displacement of metal surfaces,** Ady Levy, Nabil M. Amer, *Thomas J. Watson Research Center, IBM, Route 134, P.O. Box 218, Yorktown Heights, NY 10598.* Picosecond photothermal displacement experiments were carried out to investigate the applicability of the photothermal effect in time-resolved scanning probe microscopy. The time evolution of the surface displacement of nickel was measured and the rise time was 100 picoseconds, in agreement with the prediction of the 1D linearized hydrodynamic theory.

15:15
C3 6 MHH6 (Invited) **Ultrafast voltage contrast scanning probe microscopy,** D. M. Bloom, A. S. Hou, F. Ho, B. A. Nechay, *Stanford University, Stanford, CA 94305.* We have developed a new tool for measuring ultrafast voltages on integrated circuit devices. The scanning-force microscope probing system has 100-ps, submicron resolution and the ability to probe through passivating layers.

SESSION D'6 [MTT]: JOINT SYMPOSIUM ON SPECTROSCOPIC APPLICATIONS FOR ENVIRONMENTAL STUDIES: LASER DIAGNOSTICS FOR HAZARDOUS EMISSIONS MONITORING: 1

Monday afternoon, 3 October 1994
Loews Anatole Hotel
Governors Lecture Hall at 16:00
Terry Cool, presiding

16:00
D'6 1 MTT1 (Invited) **Detection of pollutants by multiphoton ionization spectroscopy,** Ulrich Boesl, Ralf Zimmermann, *Institute of Physical and Theoretical Chemistry Technical University of Munich, Lichtenbergstr. 4, D-85747 Garching, Germany. E-mail: boesl@tuch.phys.chemie.tu-muenchen.de.* Resonance-enhanced two-photon ionization in combination with a high-resolution time-of-flight mass analysis and a heatable supersonic-beam inlet system (laser mass spectrometry) is used for pollutants detection. We have examined the possibility of isomer selective ionization of representatives of the following pollutant classes: chlorinated dibenzo-p-dioxins; chlorinated biphenyls; chlorinated benzenes; polycyclic aromatic compounds.[1] Replacing two-photon ionization by multiphoton ionization of higher order, other classes of molecules are detectable such as nitrogenoxides, carbonmonoxide, aldehydes, and others. These latter pollutants are components of exhaust emissions from combustion engines. For their detection a very fast analysis on the time scale of a few milliseconds is necessary. Laser spectroscopy/laser mass spectrometry is an ideal tool for this task.[2]

1. C. Weickhardt, R. Zimmermann, U. Boesl, E.W. Schlag, Rapid Commun. Mass Spectrom. **7**, 183 (1993).
2. U. Boesl, C. Weickhardt, R. Zimmermann, S. Schmidt, H. Nagel, SAE Technical Paper Series 930083, 61 (1993).

16:30
D'6 2 MTT2 **Detection of combustion intermediates by VUV ionization spectroscopy,** Sunita Satyapal, James H. Werner, Terrill A. Cool, *Applied and Engineering Physics, Cornell University, Ithaca, NY 14853. I:sunita@msc.cornell.edu.* Molecular beam sampling time-of-flight mass spectrometry has been used to study the structure of premixed laminar flames seeded with trace amounts of various additives. Hydrogen-oxygen and methane-oxygen flames have been doped with chlorinated hydrocarbons or organophosphonates including trichloroethylene, methyl chloride, carbon tetrachloride, and dimethyl methylphosphonate. Relative concentration profiles have been obtained for radicals and stable species as a function of burner distance from the sampling probe. The ionization of species is accomplished by two methods. VUV radiation (118-180 nm) is generated by either frequency tripling or difference frequency mixing in rare gases and is used to directly ionize species with ionization potentials below the energy of the incident photon. Qualitative information may be obtained on species with high ionization potentials such as O_2, O, and H_2O by laser-generated electron-impact ionization. The results of these studies provide useful information for detailed kinetic modeling of chlorinated hydrocarbon and organophosphonate flames.

16:45
D'6 3 MTT3 **Vacuum ultraviolet photoionization spectrometry for the investigation of hazardous emissions,** Lisa Pfefferle, *Department of Chemical Engineering, Yale University, New Haven, CT 06520-8286.* Vacuum ultraviolet photoionization mass spectrometry provides a powerful "soft-ionization" method for detection of hydrocarbons and hydrocarbon radicals. Quantitative analysis of products of benzene oxidation using VUV photoionization MS including theoretical means for estimating relative ionization and detection efficiencies is described. Both calibration methodology and error analysis are emphasized.

SESSION D'1 [MUU]: SYMPOSIUM ON COHERENT PHENOMENA ON CHEMISTRY AND PHYSICS: COHERENT CONTROL IN CHEMISTRY: 2

Monday afternoon, 3 October 1994
Loews Anatole Hotel
Senators Lecture Hall at 16:00
Edward R. Grant, presiding

16:00
D'1 1 MUU1 (Invited) **Coherent and incoherent laser control of chemical dynamics,** Moshe Shapiro, *Department of Chemical Physics, The Weizmann Institute, Rehovot, 76100, Israel.* The control of elementary molecular processes with coherent and incoherent light by extending our past theoretical work on weak-field coherent control to the strong field domain is discussed. Emphasis is placed on two particular processes: adiabatic passage to the contimuum and incoherent interference control.

16:30
D'1 2 MUU2 (Invited) Multiple-pulse and phase-locked studies of coherence in chemical processes, P. Vohringer, D. C. Arnett, T. Y. Yang, N. F. Scherer, *Department of Chemistry, University of Pennsylvania, Philadelphia, PA 19104-6323. E-mail: schere@a.chem.upenn.edu.* The dynamics of optical phase relaxation manifest in photon echo measurements are simulated using measured solvent spectral densities. The mechanisms of chromophore-solvent interaction are elucidated for different chromophores, that range from weakly to strongly interacting, through comparative studies in different liquids. Simulations include vibrational mode displacements obtained from other $P^{(3)}$ measurements. The intra- and intermolecular dynamics of liquids are examined via heterodyne-detected 3-pulse scattering measurements to establish the real and imaginary components of all unique tensor elements. Valuable insight is gained into the relaxation of intermolecular modes. Phase-locked heterodyne detection of the real and imaginary nonlinear spectroscopic tensor elements is discussed. These studies suggest more appropriate model forms for lineshape functions in the photon echo simulations.

17:00
D'1 3 MUU3 Coherent control in the photodissociation of HI, Denis J. Gendron, Andreas Mank, John W. Hepburn, *CMBLC, Department of Chemistry, University of Waterloo, 200 University Avenue, Waterloo N2L 3G1 Canada. E-mail: DGENDRON@Watstar.chemistry.uwaterloo.ca.* A test of the Asaro-Brumer-Shapiro scheme for coherent control over product angular distributions has been performed on the photodissociation of HI in the first continuum. Using H-atom Doppler spectroscopy, we have probed the product branching ratio as a function of recoil angle using elliptically-polarized photolysis laser.

17:15
D'1 4 MUU4 Quantum control of vibrational dynamics with tailored femtosecond pulses, Vladislav V. Iakovlev, Bern Kohler, Jeffrey L. Krause, Robert M. Whitnell, Kent R. Wilson, YiJing Yan,* *Department of Chemistry, University of California, San Diego, La Jolla, CA 92093-0339. E-mail: bkohler@ucsd.edu.* By manipulating the phase of femtosecond optical pulses, control of vibrational dynamics of iodine molecules is demonstrated. Using theory to guide the choice of pulse shape, we have varied the chirp of a femtosecond pump pulse and observed the changes in the wave packet dynamics by femtosecond laser-induced fluorescence.
**Hong Kong University of Science and Technology, China.*

SESSION D'2 [MVV]: SYMPOSIUM ON NEW WAVELENGTH SOLID-STATE LASERS
Monday afternoon, 3 October 1994
Loews Anatole Hotel
Topaz Room at 16:00
Joseph Pinto, presiding

16:00
D'2 1 MVV1 (Invited) New all-solid-state lasers from the UV to the mid-IR, L. Esterowitz, J. Pinto, G. Rosenblatt, *Naval Research Laboratory, 4555 Overlook Avenue, SW, Washington, DC 20375.* Continuously-tunable UV laser operation in Ce:LiSAF between 285 and 297 nm is discussed. Using quadrupled Nd:YAG in a transversely-pumped configuration, UV energies in the millijoule range are extracted. CW laser operation of the Er:YLF $^4F_{9/2}$--> $^4I_{9/2}$ transition at 3.4 microns is reported. Laser output powers of 10 mw and slope efficiencies of 2% have been achieved. The upper laser level is directly pumped at 650 nm. The availability of red diodes for pumping and the possibility of tuning this transition in this mid-IR region makes this laser system very attractive.

16:30
D'2 2 MVV2 Possibilities and problems of Ce^{3+}:$La_2Be_2O_5$ as a tunable laser crystal, Y. M. Cheung, S. K. Gayen, *Department of Physics and Engineering Physics, Stevens Institute of Technology, Hoboken, NJ 07030. E-mail: YICHEUN1@VAXC.STEVENS-TECH.EDU.* Broadband absorption (230-400 nm) and emission (400-600 nm) due to strong 4f ⇔ 5d transitions seemed to make Ce^{3+}:$La_2Be_2O_5$ a promising crystal for operation as a tunable blue-green laser. However, ultraviolet pumping into its absorption bands creates transient and long-lived absorbing centers completely inhibiting probable laser action.

16:45
D'2 3 MVV3 Photochemical stability and tunability of LiLuF4:Ce3+ UV active medium, M. A. Dubinskii, V. V. Semashko, A. K. Naumov, R. Yu. Abdulsabirov, S. L. Korableva, *Kazan State University, 420008 Kazan, Russia. E-mail: root@scikgu.kazan.su.* LiLuF4:Ce3+ is a recently discovered active medium for tunable solid-state UV lasers and amplifiers of ultrashort pulses. The results of photochemical stability studies of this prospective material, which was found to be very sensitive to various impurities of growth starting materials, is reported. Tunability of LiLuF4:Ce3+ laser have been studied and it was shown that besides the fluorescence features it is strongly connected with the photochemical transformations in the samples under the intense UV pumping.

17:00
D'2 4 MVV4 (Invited) High-powered diode-based visible lasers, G. J. Dixon, A. Said, Q. Zhang, *Center for Research on Electro-Optics and Lasers, University of Central Florida, Orlando, FL 32826.* The recent development of high-powered coherent semiconductor lasers and progress in diode-pumped intracavity frequency mixing are expected to lead to watt-level, diode-based visible lasers for video projection and other applications. Operating principles and progress in the development of a high-powered intracavity-doubled signal-resonant sum-frequency laser with outputs at 467 and 423 nm is reported.

SESSION D'3 [MWW]: SYMPOSIUM ON OPTICAL-INDUCED COHERENCES IN SEMICONDUCTORS: 2
Monday afternoon, 3 October 1994
Loews Anatole Hotel
Sapphire Room at 16:00
Duncan Steel, presiding

16:00
D'3 1 MWW1 (Invited) Ultrafast electronic and vibrational dynamics in semiconductor nanocrystals, D. M. Mittleman, R. W. Schoenlein, J. J. Shiang, V. L. Colvin, A. P. Alivisatos, C. V. Shank, *Lawrence Berkeley Laboratory, MS 70-193A, 1 Cyclotron Road, Berkeley, CA 94720. E-mail: daniel@physics.berkeley.edu.* The femtosecond dynamics of quantum-confined excitons in CdSe nanocrystals are measured using three-pulse photon echoes. The induced polarization is modulated by coupling to vibrational modes of the nanocrystals. As a result, electronic and vibrational dynamics can be investigated simultaneously. These dynamics are strongly dependent on the degree of quantum confinement.

16:30
D'3 2 MWW2 Excitation-dependent polarization behavior of the four-wave mixing signal in MQWs, Shekhar Patkar, W. Sha, A. E. Paul, Arthur L. Smirl, *Center for Laser Science and Engineering, 100 Iowa Advanced Technology Laboratories, The University of Iowa, Iowa City, IA 52242-1000. I: art-smirl@.uiowa.edu.* We have measured, for the first time, to our knowledge, all the Stokes' parameters of the time-integrated four-wave mixing signal in MQWs, as a function of relative input polarizations. The degree of polarization and ellipticity are strongly dependent on the intensity of the irradiating pulses and give important information about the density-dependent dephasing processes.

TUESDAY MORNING

16:45
D'3 3 MWW3 Femtosecond coherent spectroscopy of ZnCdSe/ZnSe quantum wells, A. J. Fischer, D. S. Kim, J. Hays, W. Shan, J. J. Song, D. B. Eason,* J. Ren,* J. F. Schetzina,* H. Luo,** J. K. Furdyna,** *Center for Laser Research and Department of Physics, Oklahoma State University, Stillwater, OK 74078.* Strong femtosecond nonlinear diffracted signals up to the 13th order are found in a two-beam, self-diffraction geometry from a relatively thin ZnCdSe/ZnSe quantum well sample. We study these diffracted signals in the spectral domain, and as a function of time delay.
**North Carolina State University. **University of Notre Dame.*

17:00
D'3 4 MWW4 Femtosecond spectral hole-burning in InP quantum dots at room temperature, H. Giessen, B. Fluegel, G. Mohs, N. Peyghambarian, J. R. Sprague,* A. J. Nozik,* *Optical Sciences Center, University of Arizona, Tucson, AZ 85721. Internet: Giessen@CCIT.arizona.edu.* Quantum-confined states in III-V semiconductor microcrystallites are resolved for the first time by femtosecond spectroscopy. Pump-probe experiments performed on InP quantum dots (2.6 nm) dispersed in toluene show a large homogeneous linewidth. The spectral hole rises within 250 fs and persists for at least 200 ps. We report on the size dependence and solvent influence of our results.
**National Renewable Energy Laboratory.*

SESSION D'4 [MXX]: SYMPOSIUM ON STRONG FIELDS IN NONLINEAR OPTICS
Monday afternoon, 3 October 1994
Loews Anatole Hotel
Wedgwood Room at 16:00
Yehiam Prior, presiding

16:00
D'4 1 MXX1 (Invited) Renormalized nonlinear optical interactions in localized (atomic) and distributed (semiconductor) electronic media, T. K. Gustafson, Vivien Lee, Patrick Harshman, *Department of Electrical Engineering and Computer Sciences, University of California at Berkeley, Berkeley, CA 94720. Internet: tkg@eecs.berkeley.edu.* Strong-field nonlinear optical interactions have recently received attention as a means of improving conversion efficiencies or otherwise altering various nonlinear optical processes. Recently developed renormalization techniques are discussed as a means of treating such strong-field limits. An overview of experimental results in atomic and semiconductor quantum-wells is presented.

16:30
D'4 2 MXX2 (Invited) Nonlinear optics using electronically-induced transparency, S. E. Harris, *Edward L. Ginzton Laboratory, Stanford University, Stanford, CA 94305.* A strong control field applied to a medium will cause the medium to become transparent and to have unity refractive index. An overview of theoretical and experimental results is provided and applications to nonlinear optics, matched pulse generation, and optical switching are discussed.

17:00
D'4 3 MXX3 Electromagnetic field-induced quenching of the effects of noisy lasers, K. V. Vasavada, Gautam Vemuri, G. S. Agarwal,* *Department of Physics, Indiana University-Purdue University, 402 N. Blackford Street, Indianapolis, IN 46202. Internet: gvemuri@indyvax.iupui.edu.* By studying the spectrum of flueorescence from a two-level atom irradiated by intense, bichromatic fields, where one component is coherent and the other stochastic, we show a way to quench the influence of the noisy field. A dressed-state analysis reveals that the Rabi sidebands can be narrowed by a factor of four.
**University of Hyderabad, India.*

17:15
D'4 4 MXX4 Multiphoton-ionization-asymmetries in Autler-Townes doublet induced by nonlinear-optical-generation, G. Z. Zhang, K. Hakuta, *Department of Applied Physics and Chemistry, and Institute for Laser Science, University of Electro-Communications, Chofu, Tokyo 182, Japan. Internet: hakuta@newsl.ils.uec.ac.jp.* Multiphoton-ionization processes in a strongly-coupled atomic system are investigated theoretically and experimentally using atomic hydrogen as a test medium. Nonlinear optical interactions create two excitation pathways for the strongly-coupled upper states which interfere destructively or constructively, resulting in asymmetric Autler-Townes doublet in the multiphoton-ionization spectra.

SESSION PL7 [TuA]: ILS PLENARY: 2
Tuesday morning, 4 October 1994
Loews Anatole Hotel
Grand B Room at 8:30
Jagdeep Shah, presiding

8:30
PL7 1 TuA1 (Plenary) Ultrashort pulse lasers that combine versatility with practicality, Wilson Sibbett, *University of St. Andrews, UK.* Abstract not available at press time.

SESSION E4 [TuG]: JOINT SYMPOSIUM ON ADVANCED OPTICAL TECHNIQUES FOR MEDICAL DIAGNOSTICS : SPECTROSCOPY 1
Tuesday morning, 4 October 1994
Loews Anatole Hotel
Wedgwood Room at 8:00
Stephen L. Jacques, presiding

8:00
E4 1 TuG1 (Invited) Diagnosis and imaging using Raman spectroscopy, Michael S. Feld, *G. R. Harrison Spectroscopy Laboratory, Massachusetts Institute of Technology, Cambridge, MA 02139. E-mail: msfeld@mit.edu.* Laser spectroscopy can be used to diagnose disease and extract histochemical information. Reflectance, absorption, fluorescence, and Raman scattering in the IR, visible, and ultraviolet can all be used without the use of exogenous (external) dyes. Data can be obtained in real time during clinical procedures using optical-fiber contact probes, needles, and endoscopic imaging techniques. Biopsy is not required, and the methods are nonpertubative. Laser-induced fluorescence has been widely studied. In addition, vibrational techniques have recently begun to be explored. Raman spectroscopy appears to be the most promising of these. Clinical results and their biophysical basis are presented. Prospects for spectral imaging in two and three dimensions are discussed.

8:30
E4 2 TuG2 (Invited) Native tissue fluorescence in normal, preneoplastic, and neoplastic tissue of the aerodigestive mucosa, Howard E. Savage, Venteswara Kolli, Rajiv Chandawarkar, Jianchun Zhang, John F. Ansley, Robert R. Alfano,* *Memorial Sloan-Kettering Cancer Center, 425 E. 67 Street, New York, NY 10021.* Intrinsic tissue and cellular fluorescence can discriminate normal, preneoplastic, and neoplastic aerodigestive mucosa. These spectral characteristics are reflective of tissue attributes including metabolism, proliferation, differentiation, and histo-architecture and can be modulated by various chemopreventive agents. Intrinsic tissue fluorescence has potential as a cancer screen and as an intermediate endpoint biomarker in chemoprevention trials.
**City College of the City University of New York.*

9:00
E4 3 TuG3 **Laser fluorescence spectroscopy for detecting early lesions in altherosclerosis**, Tami N. Glenn, Alexander A. Oraevsky, Steve L. Jacques,* Frank K. Tittel, Philip D. Henry,** *Electrical and Computer Engineering, Rice University, P.O. Box 1892, Houston, TX 77251. Internet: tami@owlnet.rice.edu.* Using dye-enhanced fluorescence diagnostics to detect oxidative bursts associated with NO production and an amperometric electrode for NO quantification, we are developing an optical biopsy to detect early endothelial cell changes potentially leading to atherosclerosis. Additionally, we are studying laser-induced fluorescence of lipid-loaded macrophages to aid detection of foam cell deposition in arterial walls during early atherosclerosis.
**University of Texas MD Anderson Cancer Center. **Baylor College of Medicine.*

9:15
E4 4 TuG4 **Fluorescence imaging system for the detection of precancer and cancer of the human cervix**, Constantinos Pitris, Rebecca Richards-Kortum, Michelle Follen-Mitchell,* *Department of Electrical and Computer Engineering, University of Texas at Austin, Austin, TX 78712.* A multi-pixel Ωuorescence imaging system was developed for use in cervical precancer diagnosis. The system consists of a probe, a CCD camera, and an imaging spectrograph and it is capable of obtaining the Ωuorescence spectra from 31 points simultaneously. The characteristics and clinical applications of this project are presented.
**The University of Texas MD Anderson Cancer Center.*

SESSION E'1 [TuL]: JOINT SYMPOSIUM ON ULTRAFAST LASER SOURCES
Tuesday morning, 4 October 1994
Loews Anatole Hotel
Senators Lecture Hall at 9:00
Anthony M. Johnson, presiding

9:00
E'1 1 TuL1 (Invited) **Fiber-based short-pulse amplification and manipulation circuitry**, David J. Richardson, *Optoelectronics Research Centre, Southampton University, Southampton SO17 1BJ, UK. E-mail: B:d,r@orc.soton.ibm.* A number of fiber-based short-pulse transformation circuits that can be used to extend the capability and usefulness of conventional fiber-based short-pulse systems are described. Pulse transformations ranging from simple amplification and compression to spectral inversion and dark-soliton formation are covered and the potential applications of such circuitry discussed.

9:30
E'1 2 TuL2 (Invited) **Ultrafast solid-state lasers using semiconductor saturable absorbers**, Ursula Keller, *ETH, Switzerland.* Passive modelocking of solid-state lasers using semiconductor absorbers is reviewed. An A-FPSA inside Nd:glass and Cr:LiSAF lasers produced sub- 100-fs pulses. We show that even a slow saturable absorber is able to stabilize solitary pulses much shorter than the recovery time of the absorber.

SESSION F1 [TuU]: JOINT SYMPOSIUM ON SPECTROSCOPIC APPLICATIONS FOR ENVIRONMENTAL STUDIES: LASER DIAGNOSTICS FOR HAZARDOUS EMISSIONS MONITORING: 2
Tuesday morning, 4 October 1994
Loews Anatole Hotel
Senators Lecture Room at 10:30
Terry Cool, presiding

10:30
F1 1 TuU1 (Invited) ***In situ* detection of chlorinated hydrocarbons**, Donald Lucas, Charles McEnally,* Stephen G. Buckley,* Catherine P. Koshland,** Robert F. Sawyer,* *Energy and Environment Division, Lawrence Berkeley Laboratory, Berkeley, CA 94720. E-mail: lucas@ux5.lbl.gov B.* Chlorinated hydrocarbons are detected in gas mixtures and in combustion environments by dissociating the parent compounds with a 193-nm laser and measuring the concentration of the CC1 fragment via LIF. Every chlorinated hydrocarbon tested was measurable, with sub-ppm detection limits using 50 laser shots.
**Department of Mechanical Engineering, University of California, Berkeley. **Department of Biomedical and Environmental Health Science, University of California, Berkeley.*

11:00
F1 2 TuU2 **Detection of chlorinated hydrocarbons via laser-atomization/LIF**, Jay B. Jeffries, *Molecular Physics Laboratory, SRI International, Menlo Park, CA 94025. E-mail: Jeffries@MPLVAX.sri.com.* Atomic chlorine is the dominant photofragment from 193 photolysis of chlorinated hydrocarbons (CHCs); therefore LIF detection of CI provides a sensitive (sub ppb) monitor of the presence of total CHCs without species selectivity. HCI and series of substituted methanes and ethylenes are studied in a variety of bath gases including air and no optical interference to two-photon CI LIF is found.

11:15
F1 3 TuU3 **Photodissociation and reaction dynamics studied by REMPI and single-photon ionization**, Deirdre A. Belle-Oudry, Sunita Satyapal, Thibaud Mussillon, Paul L. Houston, *Department of Chemistry, Cornell University, Ithaca, NY 14853. E-mail: deirdre@chemres.tn.cornell.edu.* We have investigated the photodissociation and reaction dynamics of chemical warfare agent simulants using laser ionization in combination with time-of-flight mass spectrometry to probe the products. Specifically, resonance-enhanced multiphoton ionization has been used to probe three different photofragments (CI, P, and PO) in the 193-nm dissociation of phosphoryl chloride ($POCl_3$). In addition, studies using radical species produced by excimer laser photolysis of parent molecules (e.g. OH radicals from HNO_3 at 193 nm) in crossed-molecular beam reactions with molecular species are currently underway. In these experiments, products are probed via single-photon ionization using vacuum ultraviolet radiation.

11:30
F1 4 TuU4 **Study of laser-induced breakdown spectroscopy in an aerosol**, Jagdish P. Singh, Hansheng Zhang, Fang-Yu Yueh, Robert L. Cook, *Diagnostic Instrumentation and Analysis Laboratory, Mississippi State University, Mississippi State, MS 39762. E-mail: SING@DIAL.MSSTATE.EDU.* Study of laser-induced breakdown spectroscopy (LIBS) has been performed in the aerosol to optimize the minimum metal concentration measurement. LIBS spectra of known concentration of Na and Cu were used to calibrate the LIBS signal for absolute concentration measurements. A metallic solution is injected into air, CH_4/air flame, and in a heated cell to generate aerosol at different temperatures. A frequency-doubled Nd-YAG laser (532 nm) is focussed into the aerosol to produce the electrical breakdown (spark). The emission from spark is collected in backward direction at a small angle from the laser beam and also in the direction normal to the laser beam. The LIBS signal is coupled to an optical fiber and detected with a spectrograph and a gated vidicon detector. Spectra were recorded at different time delays and gate pulse-widths to obtain the most sensitive detection condition. The study at various aerosol conditions was performed under the best detection condition and the results are compared to study the effect of environmental temperature on LIBS spectra. This study was also used to predict optimum sensitive LIBS measurement in a simulated stack condition. Various mixtures of Na and Cu salt solutions were injected to record simultaneously the Na and Cu LIBS spectra. This experiment is used to calibrate the LIBS spectra for the absolute concentration measurement.

SESSION F2 [TuV]: JOINT SYMPOSIUM ON ULTRASHORT PULSE SOLID-STATE LASERS: 1
Tuesday morning, 4 October 1994
Loews Anatole Hotel
Topaz Room at 10:30
Anthony Johnson, presiding

10:30
F2 1 TuV1 (Invited) **Review of femtosecond pulse generation in solid-state lasers - capabilities and limitations,** M. M. Murnane, H. C. Kapteyn, J. Zhou, C. P. Huang, G. Taft, M. T. Asaki, *Department of Physics, Washington State University, Pullman, WA 99164-2814. E-mail: murnane@wsuvm1.csc.wsu.edu.* Recent advances in solid-state femtosecond laser technology, which have made possible the generation of ultrashort pulses of unprecedented duration, tunability, and power are reviewed. The ultimate limits to femtosecond pulse generation, from both laser oscillators and amplified systems, are discussed.

11:00
F2 2 TuV2 **Generation of tunable 30-fs pulses by optical parametric amplification,** Vladislav V. Iakovlev, Bern Kohler, Kent R. Wilson, *Department of Chemistry, University of California, San Diego, La Jolla, CA 92093-0339. E-mail: vyakovlev@ucsd.edu.* An all-solid-state laser system which generates tunable IR and visible femtosecond pulses at kHz repetition rates is described. Output from a Ti:sapphire regenerative amplifier is used to generate a white-light continuum, the IR portion of which is parametrically amplified. After compression pulses as short as 30 fs are measured with energies of several microjoules.

11:15
F2 3 TuV3 **Design of a high-repetition-rate femtosecond optical parametric oscillator-amplifier system operating near 3 microns,** Gary R. Holtom, Robert A. Crowell, X. Sunney Xie, *Pacific Northwest Laboratory, Molecular Science Research Center, P.O. Box 999, MS K2-14, Richland, WA 99352. E-mail: gr_holtom@pnl.pnl.gov.* An ultrafast mid-IR laser system based on a Ti:sapphire laser and regenerative amplifier, followed by an optical parametric oscillator and amplifier, is demonstrated. Noncritically phase-matched KTP crystals are used to obtain high gain at 2.75 μm. Pulses with an energy of 0.2 μJ, a repetition rate of 250 KHz, and a width of 200 fs are obtained.

11:30
F2 4 TuV4 **Short pulses from a modelocked Ti:sapphire laser with a solid-state phase modulator,** Warren P. Grice, Ian A. Walmsley, *The Institute of Optics, University of Rochester, Rochester, NY 14627. E-mail: wgri@lle.rochester.edu.* Sub 40-fs pulses in a modelocked Ti:sapphire laser using regenerative intracavity phase modulation as a self-starting mechanism is demonstrated. Novel design of the phase modulator permits exploitation of the electro-optic effect in a Brewster-cut crystal while minimizing the amount of material dispersion introduced into the cavity.

11:45
F2 5 TuV5 **A generalized radon transform for tomographic measurement of ultrashort optical pulses,** Daniel F. V. James, Girish S. Agarwal,* *The Institute of Optics, University of Rochester, Rochester, NY 14627. E-mail: james@moe.optics.rochester.edu.* A method, based on chronocyclic tomography,[1] for determining the Wigner function associated with the profile of a short pulse, which is applicable to a broad class of optical systems, is proposed.
1. Opt. Letts. **18**, 2041 (1993).
**University of Hyderabad, India.*

SESSION F3 [TuW]: PHYSICS OF SOLID-STATE SOURCES AND MATERIALS
Tuesday morning, 4 October 1994
Loews Anatole Hotel
Sapphire Room at 10:30
Joseph Pinto, presiding

10:30
F3 1 TuW1 **Direct measurements of lower-level lifetime in Nd:YLF,** J. D. Zuegel, W. Seka, *Laboratory for Laser Energetics, University of Rochester, 250 East River Road, Rochester, NY 14623-1299. E-mail: zuegel@lle.rochester.edu.* Direct measurements of the lower-level lifetime of Nd:YLF are reported. Small-signal gain recovery and excited-state absorption from the lower level are measured with subnanosecond accuracy after saturating a sample with an impulse-like probe pulse. Stored energy extraction performance is also measured and compared to the dynamic measurements.
This work was supported by the U.S. Department of Energy Office of Inertial Confinement Fusion under Cooperative Agreement No. DE-FC03-92SF19460 and the University of Rochester. The support of DOE does not constitute an endorsement by DOE of the views expressed in this article.

10:45
F3 2 TuW2 **Site-selective measurements of nonradiative relaxation rates of $^4G_{5/2}$+$^2G_{7/2}$ multiplet of Nd^{3+} ion in SrF_2:Nd^{3+} and SrF_{2x}:$LaF_{3(1-x)}$:Nd^{3+} laser crystals,** Yu. V. Orlovskii, T. T. Basiev, I. N. Vorobév, O. K. Alimov, A. G. Papashvili, V. V. Osiko, *Institute of General Physics of the Russian Academy of Sciences, 38 Vavilov St., Moscow 117942, GSP-1, Russian Federation. Internet: orlovsk@fft.gpi.msk.su.* The direct measurements of the nonradiative relaxation rates of the high-lying $^4G_{5/2}$+$^2G_{7/2}$ multiplet of Nd^{3+} -ion in the ordered multi-center SrF_2:Nd^{3+} and in the new disordered SrF_{2x}:$LaF_{3(1-x)}$:Nd^{3+} laser crystals versus the excitation wavelength were done. In accordance with these measurements the multiphonon nonradiative relaxation rates (W_{MNR}) in the tetragonal (L), orthorhombic (M), and complex trigonal (N) symmetry centers in SrF_2:Nd^{3+} crystal were estimated.

11:00
F3 3 TuW3 **Energy transfer between thulium and holmium in 2.1-micron laser materials,** Kenneth M. Dinndorf, Hans P. Jenssen, *Laboratory for Advanced Solid State Laser Materials, Massachusetts Institute of Technology, Cambridge, MA 02139. Internet: dinndor@eglin.af.mil.* Energy transfer between the manifolds of thulium and holmium are discussed. Relations between the parameters for energy-transfer and back-transfer between the first excited-state manifolds of both ions are derived and experimentally verified. Relations between upconversion and cross-relaxation processes are also derived and experimentally explored.

11:15
F3 4 TuW4 **Improved Sellmeier coefficients for potassium titanyl arsenate, KTiOAsO_4 (KTA),** Dale L. Fenimore, Kenneth L. Schepler, Uma B. Ramabadran, *Wright Laboratory, Wright-Patterson AFB, OH 45433. E-mail: fenimore@elmo.wpafb.af.mi.* KTA is a crystallographic isomorph of KTP, a well-known biaxial nonlinear crystal used to generate mid-IR radiation. KTA shows promise for generating wavelengths throughout the 2-5 micron region. Published Sellmeier coefficients are not valid for predicting behavior beyond 1.5 microns. We have found valid coefficients for the entire KTA transparency region.

11:30
F3 5 TuW5 **The role of back conversion in pulsed optical parametric oscillators,** Arlee V. Smith, Mark S. Bowers,* *Sandia National Laboratories, P.O. Box 5800, Albuquerque, NM 87185. E-mail: arlsmit@sandia.gov.* We have developed a numerical model for nanosecond optical parametric oscillators (OPOs) that calculates time-

dependent optical fields on an x-y spatial grid. It includes walk-off, diffraction, and pump depletion. The model predicts OPO performance including efficiency, pulse shapes, beam profiles, spectra, and beam quality. These predictions are compared with detailed experimental characterization of a ring KTP OPO to validate the model. The model is used to determine which design factors influence OPO beam quality. We find it is strongly influenced by back-conversion of signal and idler photons back to pump photons. The influence of pump-beam size, cavity length, and noncollinear phase-matching is discussed.
**Aculight Corporation.*

11:45
F3 6 TuW6 Pulse dynamics of a synchronously-pumped optical parametric oscillator, E. C. Cheung, Karl Koch, Gerald T. Moore,* *Nonlinear Optics Center of Technology, U.S. Air Force Phillips Laboratory, 3550 Aberdeen Avenue, SE, Kirtland AFB, NM 87117-5776. E-mail: ericc hpyap.plk.af.mil.* The pulse dynamics of a singly-resonant, $AgGaS_2$ optical parametric oscillator, synchonously pumped by a continuous-wave, actively mode-locked Nd:YAG laser is described. Fresnel reflections of the idler inside the nonlinear crystal cause the appearance of satellite pulses and increase the range of cavity-length detuning.
**University of New Mexico.*

SESSION F4 [TuX]: SYMPOSIUM ON ADVANCED OPTICAL TECHNIQUES FOR MEDICAL DIAGNOSTICS: SPECTROSCOPY: 2
Tuesday morning, 4 October 1994
Loews Anatole Hotel
Wedgwood Room at 10:30
Howard E. Sa Vage, presiding

10:30
F4 1 TuX1 (Invited) Medical application of spectroscopies in gynecology and obstetrics, Wenling Glassman, C. H. Liu,** R. Garfield,* M. Byam-Smith,* R. R. Alfano,** *Department of Surgery, University of Texas Medical Branch, 6.146 John Sealy, Route #E27, Galveston, TX 77555.* Autofluorescence from intrinsic fluorophors in tissues and cells provides a strong base for diagnostic techniques for certain diseases. The study of the fluorescence emission and excitation spectroscopy and FTIR Raman spectroscopy from cancerous and normal gynecological tract shows a myriad of possible applications of spectroscopy as a diagnostic tool for cancer tumors. Extended studies have also shown the possible application of spectroscopy in obstetric care.
**Department of Obstetrics and Gynecology. **City University of New York.*

11:00
F4 2 TuX2 (Invited) Measurement of optical properties of tissues, Steven L. Jacques, *University of Texas M.D. Anderson Cancer Center, 1515 Holcombe Blvd., Houston, TX 77030. E-mail: slj@laser.mda.uth.tmc.edu.* A toolkit of methods for measurement of tissue optical properties is presented. The influence of tissue optical properties on light delivery/collection by spectroscopic devices is discussed.

11:30
F4 3 TuX3 One- and two-photon confocal fluorescence of turbid media, Rebecca Richards-Kortum, Glenn Criswell, Mitch Weikert, *Department of Electrical and Computer Engineering, The University of Texas at Austin, Austin, TX 78712. E-mail: kortum@ece.utexas.edu.* Fiber-optic spectrometers to measure fluorescence of turbid media with 3D resolution have been tested. Using single-photon excitation, 3-micron lateral and 40-micron axial resolution were achieved with a confocal geometry. With two-photon excitation, similar resolution can be achieved, but the confocal geometry is not required.

11:45
F4 4 TuX4 Time-resolved reflectance spectroscopy on tissues with strongly-varying optical properties, Andreas H. Hielscher, Hanli Liu,* Lihong Wang,** Briton Chance,* Steven L. Jacques,** Frank K. Tittel,*** *Department of Electrical and Computer Engineering, Rice University, P.O. Box 1892, Houston, TX 77251-1892. Internet: hielsch@laser.mda.uth.tmc.edu.* Blood often has a 20-40 times higher absorption coefficient than the background tissue (e.g. white matter). The arachnoid, a sublayer of the meninges, is almost absorption and scattering-free. The influence of these kind of heterogeneities on time-resolved reflectance measurements was investigated experimentally and with Monte Carlo simulations.
**University of Pennsylvania. **U.T.M.D. Anderson Cancer Center. ***Rice University.*

SESSION G8 [TuDD]: AWARDS/PLENARY SESSION
Tuesday afternoon, 4 October 1994
Loews Anatole Hotel
Chantilly East Room at 13:30
Robert Byer, presiding

13:30
G8 1 TuDD1 (Plenary) Recent Hubble repair mission, Jeffrey Hoffman, *National Aeronautic and Space Administration*, Abstract not available at press time.

14:00
G8 2 TuDD2 From classical to quantum noise, H. A. Haus, *Department of Electrical Engineering and Computer Science and Research Laboratory of Electronics, Massachusetts Institute of Technology, Cambridge, MA 02139.* An account is given of noise in electrical circuits and its relation to quantum noise connected with Heisenberg's uncertainty principle. Nonstationary, phase-sensitive amplifiers can employ squeezed radiation and reduce the noise below that of phase-insensitive amplifiers. Experiments on squeezing in optical fibers and the attendant noise reduction are presented. Insights gained from such measurements are applied to the resolution of the Einstein-Podolsky-Rosen paradox.

14:15
G8 3 TuDD3 Laser cooling and trapping of atoms, Steven Chu, *Stanford University, Stanford, CA 94305.* The laser cooling and trapping work done at AT&T Bell Laboratories and Stanford University is reviewed, beginning with optical molasses, optical trapping, atomic fountains, and atom interferometers. More recent progress in combining laser cooling with optical trapping, improved atom optics, and applications of these atom manipulation techniques are also discussed.

SESSION G'10 [TuFF]: ILS POSTER SESSION: 1
Tuesday afternoon, 4 October 1994
Loews Anatole Hotel
Trinity Hall Room at 17:30

G'10 1 TuFF1 Femtosecond optical-Kerr-effect studies of confined liquids, Edward L. Quitevis, Manickam Neelakandan, Tracy R. Bryans, *Department of Chemistry and Biochemistry, Texas Tech University, Lubbock, TX 79409. E-mail: ufelq@ttacs1.ttu.edu.* New optical heterodyned-detected optical-Kerr-effect (OKE) measurements of the transient birefringence of liquids confined to the pores of sol-gel glasses is presented. The OKE in these systems is induced by femtosecond pulses from a mode-locked Ti:sapphire laser.

G'10 2 TuFF2 Femtosecond optical dynamics of molecular aggregates, Edward L. Quitevis, Manickam Neelakandan, Archita Sepgupta, *Department of Chemistry and Biochemistry, Texas Tech University, Lubbock, TX 79409. E-mail: ufelq@ttacs1.ttu.edu.* New time-domain measurements of the ultrashort-pulse optically-induced dichroism of the exciton states in the iodine-starch complex is presented. The transient dichroism in this system is induced by femtosecond pulses from a mode-locked Ti:sapphire laser. The decay of the anisotropy is probed by optical heterodyne detection.

G'10 3 TuFF3 Oscillation spectrum line natural self-selection of medium-size gas-flow carbon dioxide molecule gas laser with mirror resonator, Yasuyuki Saito, *Department of Engineering, Ibaraki University, 4-12-1 Nakanarusawa-cho, Hitachi 316, Japan.* Oscillation spectrum lines of a medium-size gas-flow carbon dioxide molecule gas laser were observed. The laser medium (about 10-mm bore X 1000-mm length) was excited with high a.c. voltage, for example at 10 Torr carbon dioxide: He: N2 mixture gas flow state. Three or four oscillation lines at 10.6μm were observed, which is different from the many oscillation lines of a 5000-mm long laser of C.K.N. Patel's work, in spite of the relatively high output power. This can be considered a result of spectrum line natural self-selection by a shorter resonator.

G'10 4 TuFF4 Traverse multi-mode beam unstableness of a medium-size gas-flow carbon dioxide molecule gas laser with mirror resonator and carbon dioxide molecule gas laser high gain, Yasuyuki Saito, *Department of Engineering, Ibaraki University, 4-12-1 Nakanarusawa-cho, Hitachi 316, Japan.* Oscillation beam traverse mode of a medium-size (about 10-mm bore X 1000-mm length) gas-flow carbon dioxide molecule gas laser was observed. The laser medium was excited with high a.c. voltage (max: 30 keV), for example at 10 Torr carbon dioxide: He: N2 mixture gas flow state. The observations showed multi-mode beams and unstableness. This can be considered a result of a resonator coherent state and high gain.

G'10 5 TuFF5 Low temperature line-mixing in the Raman Q-branch of D_2, Guy D. Sheldon, S. Hamid Fakhr, P. M. Sinclair, J. R. Drummond, A. D. May, *Department of Physics, University of Toronto, 60 St. George Street, Ste. 331, Toronto, ON, Canada M5S 1A7. E-mail: dmay@physics.utoronto.ca.* Raman gain spectroscopy was used to measure the Q(0) to Q(3) lines of D_2 at 100 K. Over the range of densities studied, the lines were well separated, but asymmetric due to quantum-mechanical line-mixing. From the line mixing parameters found, the vibrational dephasing and state-to-state rotational relaxation rates were deduced.

G'10 6 TuFF6 Line broadening and shifting of the Raman Q-branch in D_2 at low temperatures, S. Hamid Fakhr, Guy D. Sheldon, P. M. Sinclair, J. R. Drummond, A. D. May, *Department of Physics, University of Toronto, 60 St. George Street, Ste. 331, Toronto, ON, Canada M5S 1A7. E-mail: dmay@physics.utoronto.ca.* Using high-resolution Raman-gain spectroscopy, the pressure broadening and shifting of the Q(0) to Q(3) lines of D_2 at low densities and 100 K was measured. The contribution of dephasing and inelastic collisions to the linear shifting and broadening is discussed. Nonlinear shifting and broadening is observed at medium densities.

G'10 7 TuFF7 Formation and metastable decomposition of unprotonated ammonia cluster ions upon femtosecond ionization, S. A. Buzza, S. Wei, J. Purnell, A. W. Castleman, Jr., *Department of Chemistry, Pennsylvania State University, University Park, PA 16802.* The formation and metastable dissociation mechanism of unprotonated ammonia cluster ions, $(NH_3)_n^+$, produced by multiphoton ionization at 624 nm and a nominal pulsewidth of 350 femtoseconds, are investigated through a reflectron time-of-flight mass spectrometric technique. Detection of the unprotonated ions after femtosecond multiphoton ionization under various fluence conditions is explained and contrasted ionization through the absorption of nanosecond radiation. The presence of the unprotonated series is found to be a function of fluence in the case of ionization in the nanosecond time scale, but not so for the femtosecond time domain. The studies of metastable decomposition reveal that the unprotonated ions dissociate in the field-free region of the TOF by losing an NH_2. The findings of the present study suggest that the unprotonated ions are trapped behind the barrier to intracluster proton transfer and concomitant NH_2 loss. Additionally, isotopic investigations of the unimolecular decay reveal a strong dependence on the conditions of cluster formation. It is found that cluster formation conditions dictate the observable metastable decay. To the best of our knowledge, this is a unique example of a cluster system that does not follow Klot's evaporative ensemble model.

G'10 8 TuFF8 Multiple-photon dissociation of Freons, John L. Lyman, Brian E. Newnam, James W. Early, *Los Alamos National Laboratory, Los Alamos, NM 87545. E-mail: lyman@lanl.gov.* A series of experiments wherein an IR free-electron laser destroyed the Freons $CFCl_3$ and CF_2Cl_2 by multiple-photon dissociation is reported. The experiments explored the effects of laser frequency, laser fluence, spectral bandwidth, frequency chirping, reactant partial pressure, and air or oxygen partial pressure.

G'10 9 TuFF9 Population ratio measurement of low-energy Krypton 5s[3/2] and 5s[1/2] states in the charge-exchange process with Rb, X.-J. Pan, William M. Jr. Fairbank, *Department of Physics, Colorado State University, Fort Collins, CO 80523. I: jpan@lamar.colostate.edu.* In the charge-exchange collision between Kr^+ and Rb, two Krypton metastable states, 5s[3/2] and 5s[1/2], are populated. The ratio of the population of these states has been measured by laser-induced fluorescence as a function of Kr^+ kinetic energy in the range from 300eV to 3000eV.

G'10 10 TuFF10 State-resolved predissociative dynamics of the vinoxy (CH_2CHO) radical, Katherine I. Barnhard, Min He, Provi Mayo, Brad R. Weiner, *Department of Chemistry, University of Puerto Rico, Box 23346, UPR Station, Rio Piedras, PR 00931. E-mail: B_Weiner@UPR1.UPR.CLU.EDU.* Results on the quenching cross-sections and fluorescence lifetimes for vibrational modes of the $B^2A'' \rightarrow X^2A''$ transition of CH_2CHO are reported. A vibrational level dependence was found for the zero pressure radiative lifetime. Possible mechanisms for the vibrational dependence and results of product studies now under way are presented.

G'10 11 TuFF11 State-resolved distributions of nascent $SO(X^3\Sigma,v'')$ following SO_2 photodissociation, Xirong Chen, Fei Wu, Hongxin Wang, Brad R. Weiner, *Department of Chemistry, University of Puerto Rico, P.O. Box 23346, UPR Station, Rio Piedras, PR 00931. E-mail: B_WEINER@UPR1.UPR.CLU.EDU.* Experimental results for the vibrational, rotational, and spin-state population distributions of the nascent $SO(X^3\Sigma)$ following the 193 and 211 nm photodissociation of SO_2, both at room temperature and expanded in a free-jet, are presented.

G'10 12 TuFF12 Cavity ringdown laser absorption spectroscopy of $Er(thd)_3$, Mary T. Berry, P. Stanley May, Hong Xu, *Department of Chemistry, University of South Dakota, Vermillion, SD 57069. Internet: MBERRY@CHARLIE.USD.EDU.* The cavity ringdown absorption[1,2] spectrum of the $^4I_{15/2} \rightarrow {}^4F_{11/2}$ transition of $Er(thd)_3$[3] is reported for cold complexes entrained in a supersonic jet of inert gas. The goal of the gas-phase studies is to investigate the relaxation dynamics of the electronically-excited complexes.

1. O'Keefe and Deacon, *Rev. Sci. Instrum.* **59**, 2544 (1988).
2. O'Keefe, Scherer, Cooksy, Sheeks, Heath, and Saykally, *Chem. Phys. Lett.* **172**, 214 (1990).
3. thd = anion of 2,2,6,6-tetramethyl-3,5-heptanedione.

G'10 13 TuFF13 Lineshapes of photoassociation spectra of laser-cooled atoms, R. Napolitano, J. Weiner, C. J. Williams,* P. S. Julienne,** *Department of Chemistry and Biochemistry, University of Maryland College Park, College Park, MD 20742. E-mail: reginald@annick2.umd.edu.* Quantum mechanical close-coupled scattering calculations of the lineshapes for the photoassociation spectra were used for producing excited-bound molecular levels during the collision of two laser-cooled and trapped atoms. High-resolution lineshapes are highly asymmetric, with a blue side determined by the Wigner threshold law for the partial waves contributing to the feature, and thermal red tail sensitive to the temperature of the cold atoms.

**University of Chicago. **National Institute of Standards and Technology.*

G'10 14 TuFF14 Laser ablation of metal particles: mass distribution and kinetic energies of the desorbed species, T. Götz, W. Hoheisel, M. Stuke,* F. Träger, *Fachbereich Physik, Universität Kassel, Heinrich-Plett-Straße 40, 34132 Kassel, Germany. E-mail: hoheisel@physik.uni-kassel.de.* Ablation of metal particles with laser light of $\lambda = 355$ and 532 nm has been studied under UHV-conditions. The desorbed spears were photo-ionized with λ = 193 nm and identified by time-of-flight mass spectrometry. Under certain conditions the rate of desorbed dimers surmounts by far the rate of detected atoms.

**Max-Planck-Institut für biophysikalische Chemie.*

G'10 15 TuFF15 Spectral and spatial characteristics of cascade emissions in Na, M. Bashkansky, P. Battle, R. Mahon, J. Reintjes, *Laser Physics Branch, Code 5642, Naval Research Laboratory, Washington, DC 20375.* Experimental results of spectral and spatial properties of the laser-excited cascade emissions from a sodium vapor cell when the 3S-4P transition is excited with tunable 330-nm narowband radiation are presented. The resonance radiation was produced by frequency-doubling a dye laser operating at 660 nm, which is itself pumped by a frequency-doubled, single-mode Nd:YAG laser having pulses of 8-ns duration. The resulting 1-μJ beam has a near-Gaussian spatial mode and is collimated at a diameter of approximately 1 mm through a sodium heat pipe of length 10 cm operated at various temperatures and buffer gas pressures. An OMA and a CCD camera were used together with narrowband filters to isolate all possible cascading emissions. The origin of the conical emission profiles which are produced under certain conditions were investigated. The spatial outputs of different transitions vary depending on the degree of detuning near resonance.

G'10 16 TuFF16 Remote sensing of propane and methane using differential absorption LIDAR, Narasimha S. Prasad, Allen R. Geiger, *PetroLaser, Inc., Las Cruces, NM 88001. E-mail: nprasad@nmsu.edu.* The development and operation of a differential absorption LIDAR (DIAL) system in the 3-4 micron band is reported. Two lithium niobate optical parametric oscillators provided tunable wavelengths. The system detected propane and methane in the atmosphere, at a range greater than one mile, in a controlled release test.

G'10 17 TuFF17 Deposition of polymer thin films containing metal or semiconductor fine particles by VUV laser ablation, Shingo Inoue, Takeo Fujii, Fumihiko Kannari, *Department of Electrical Engineering, Faculty of Science and Technology, Keio University, 3-14-1 Hiyoshi, Kohoku-ku, Yokohama 223, Japan.* During deposition of PTFE (polytetrafluoroethylene) thin films by F_2 laser (157-nm) ablation, fine particles of ablated inorganic materials were doped into the polymer matrix by colliding two ablation plumes near a substrate. Material properties with a special emphasis on quantum size effects of fine particles were investigated for various processing conditions.

G'10 18 TuFF18 Photothermal spectroscopy in an optically-dense flowing medium, Qifang He, Reeta Vyas, R. Gupta, *Department of Physics, University of Arkansas, Fayetteville, AR 72701. E-mail: RG_24627@UAFSYSB.UARK.EDU.* The theory of photothermal spectroscopy in fluids has been extended to optically-thick media. The general case is considered where the fluid may be flowing. Both pulsed and cw excitation cases are considered.

SESSION PL9 [TuGG]:
ILS BANQUET
Tuesday afternoon, 4 October, 1994
Loews Anatole Hotel
Chantilly West Room at 18:30

18:30
PL9 1 TuGG1 (Plenary) Perspectives on the changing national environment for research in the physical sciences, William Harris, *National Science Foundation.* Abstract not available at press time.

SESSION H'5 [WB]: JOINT SYMPOSIUM ON LUMINESCENCE IN WIDEGAP SEMICONDUCTIVE MEDIA

Wednesday morning, 5 October 1994
Loews Anatole Hotel
Grand D Room at 8:00
Stephen Rand, presiding

8:00
H'5 1 WB1 (Invited) Photoluminescence studies of SiC, diamond, and GaN, Jaime A. Freitas, Jr., *Sachs/Freeman Associates Inc., Landover, MD 20785-5396. E-mail: FREITAS@bloch.nrl.navy.mil.* Photoluminescence spectroscopy has been applied to the characterization of wurtzite GaN, cubic SiC, and diamond. The study of the time-decay characteristics, excitation power dependence, and temperature quenching of the luminescence bands was used to identify and classify the recombination processes on the basis of radiative lifetimes and defect ionization energies.

Contract No. N00014-93-C-2227, Electronic Materials Branch Code 6874.

8:30
H'5 2 WB2 (Invited) Ultrafast and efficient phosphors from doped nanocrystals of semiconductors, Rameshwar N. Bhargava, *Nanocrystals Technology, P.O. Box 820, Briarcliff Manor, NY 10510.* By incorporating a single impurity in a quantum confined structure, high efficiency and ultrafast recombination times were simultaneously achieved. In ZnS:Mn doped nanocrystals (DNC) of 35Å size, luminescent efficiency over 20% at room temperature and luminescent decay times in subnanoseconds range was measured.

9:00

H'5 3 WB3 Spectroscopic studies of rare-earth-implanted III-V nitrides, Robert N. Schwartz, Robert G. Wilson, Ross A. McFarlane, *Hughes Research Laboratories, Malibu, CA 90265. Internet: 0004792@ msgate.emis.hac.com.* III-V nitrides have large bandgaps. GaN alloyed with AlN or InN, in particular, are attractive semiconductors for fabricating opto-electronic devices that operate in the UV and visible wavelength ranges. Spectroscopic data of rare-earth ions implanted in GaN and AlN are presented.

9:15

H'5 4 WB4 Room temperature photoluminescence measurements from crystalline Si nanostructures, Saleem H. Zaidi, An-Shyang Chu, B. Martinez-Torres, K. Jungling, S. R. J. Brueck, *Center for High Technology Materials, University of New Mexico, EECE Building Room 125, Albuquerque, NM 87131-0681. E-mail: saleem@chtm.eece.unm.edu.* Room temperature photoluminescence (PL) measurements are reported from 1D (110) Si grating structures with linewidths of 5-10 nm. Measured PL peaks vary from 550 to 650 nm, and FWHM varies from 40 to 100 nm. Investigations of PL correlation with size and surface passivation treatments are discussed.

9:30

H'5 5 WB5 Two-photon spectroscopy of homeoepitaxy ZnSe/ZnCdSe quantum wells, J. Hays, J. J. Song, J. F. Schetzina,* *Center for Laser Research and Department of Physics, Oklahoma State University, Stillwater, OK 74078. Internet: U2316aa@vms.ucc.okstate.edu.* Two-photon photoluminescence excitation spectroscopy has been performed on ZnSe/ZnCdSe quantum wells homeoepitaxially grown on ZnSe. Excitonic structures as well as the 1HH-1e continuum have been observed. This observation, in conjunction with linear absorption spectroscopy, allows direct determination of this HH exciton-binding energy.
**North Carolina State University.*

10:00

H'5 6 WB6 Color variation in organic electroluminescent semiconductors with patterned microcavities, L. J. Rothberg, A. Dodabalapur, T. M. Miller, *AT&T Bell Laboratories, 600 Mountain Avenue, Murray Hill, NJ 07974. E-mail: ananth@physics.att.com.* Details of a novel technique to vary the color of organic light-emitting diodes by placing the device structure within a patterned microcavity are described. The emission wavelength (mode position) is changed by controlling the cavity optical thickness. Light-emitting diodes with emission peaks from 490-630 nm have been fabricated.

10:15

H'5 7 WB7 (Invited) Enhanced performance of polymer light-emitting diodes using polyaniline electrodes, A. J. Heeger, Y. Yang, C. Zhang, *UNIAX Corporation, 5375 Overpass Road, Santa Barbara, CA 93111.* We have demonstrated that by using a bilayer of polyaniline (PANI) as an ultrathin film (e.g. less than 1000Å) on indium/tin oxide (ITO) as the transparent anode of polymer light-emitting diodes, device performance can be significantly improved. The operating voltage can be reduced and the quantum efficiency can be increased with respect to devices using ITO alone as the hole-injecting contact. More dramatic improvements in device performance can be achieved by using high surface area network electrodes made *in-situ* from blends of PANI. Due to the high surface area between the PANI network and the active luminescent material and to the enhancement of the local electric field at the rough surface of the PANI network, charge carrier injection is significantly improved. Devices using the PANI network electrode have lower operating voltage, higher quantum efficiency, and significantly improved brightness. External quantum efficiencies exceeding 2% have been achieved using the PANI electrode for hole injection into devices with MEH-PPV as the active luminescent polymer. The brightness at low voltages can be increased from such devices by more than two orders of magnitude to levels exceeding 400 candelas/m^2 at 4 volts.

SESSION H1 [WG]: SYMPOSIUM ON COHERENT PHENOMENA IN CHEMISTRY AND PHYSICS: COHERENT CONTROL

Wednesday morning, 5 October 1994
Loews Anatole Hotel
Senators Lecture Hall at 8:30
Philip H. Bucksbaum, presiding

8:30

H1 1 WG1 (Invited) Characterizing the quantum state of a vibrational wavepacket using emission tomography, Ian A. Walmsley, Thomas J. Dunn, Shaul Mukamel,* *The Institute of Optics, University of Rochester, Rochester, NY 14627.* A strategy for the complete characterization of the quantum state of a molecular vibrational mode by tomographic reconstruction of a certain phase-space quasi-probability function from the time-dependent spectrum of spontaneous emission is demonstrated. The distribution is related to the Wigner function, and thus the density matrix, of the vibrational wavepacket.
**Department of Chemistry.*

9:00

H1 2 WG2 (Invited) Coherent control of an atomic wavepacket using shaped light, D. W. Schumacher, J. H. Hoogenraad,* Kent R. Wilson,** P. H. Bucksbaum, *Department of Physics, University of Michigan, Ann Arbor, MI 48109-1120. E-mail: dws@gomez.physics.lsa.umich.edu.* The use of shaped light to coherently control the wavefunction of an atom is reported. We shaped 100-fs, 790-nm pulses using a liquid crystal display system. This light was used to first excite a shaped radial wavepacket in Cesium made up of p-states centered around n=25 and then to probe it.
**FOM-Institute for Atomic and Molecular Physics, The Netherlands.*
***University of California, San Diego.*

9:30

H1 3 WG3 Phase-sensitive detection and control of Rydberg electron wavepackets, Michael W. Noel, C. R. Stroud, Jr., *Institute of Optics, University of Rochester, Rochester, NY 14627. E-mail:noel@optics.rochester.edu.* Radial wavepackets are experimentally investigated with phase-sensitive pump-probe techniques. The delay between identical pump and probe pulses is controlled to a fraction of the optical period allowing us to excite and study a Schrödinger-cat-like state in which the electron is localized at two radial positions.

9:45

H1 4 WG4 Coherent optical control of electronic dynamics in coupled quantum wells: the nonimpulsive regime, P. Hyldgaard, G. D. Sanders, D. H. Reitze, *Department of Physics, University of Florida, Gainesville, FL 32611. E-mail: reitz@phys.ufl.edu.* The excitation of a simple quantum system, the asymmetric coupled quantum well, in the case where the controlling field durations are comparable to or greater than the intrinsic dephasing and oscillation times of the system is examined. It is found that tailoring the excitation field profile leads to enhancement and limited tunability of the radiated THz field.

SESSION H2 [WH]: JOINT SYMPOSIUM ON ULTRASHORT PULSE SOLID-STATE LASERS: 2

Wednesday morning, 5 October 1994
Loews Anatole Hotel
Topaz Room at 8:30
Ursula Keller, presiding

8:30

H2 1 WH1 (Invited) Dispersion measurements for femtosecond pulse generation and applications, W. H. Knox, *AT&T Bell Laboratories, 101 Crawfords Corner Road, Holmdel, NJ 07733. E-mail: 8fs@spin.att.com.* Techniques for the measurement of dispersion in bulk optical elements as well as new developments in intracavity dispersion spectroscopy are reviewed, and comments on future directions in dispersion compensation are provided.

9:00
H2 2 WH2 **Complete pulse characterization of shaped femtosecond pulses,** Vladislav V. Iakovlev, Kenneth W. Delong,* Bern Kohler, Jeff Squier,** and Rick Trebino,* *Department of Chemistry, University of California at San Diego, La Jolla, CA 92093-0339.* Femtosecond pulse characterization is vital for the generation of transform-limited pulses and tailored ultrashort light fields. Frequency-resolved optical gating (FROG) was used to characterize and optimize the performance of a Ti:sapphire chirped pulse amplifier. Pulses shaped both in amplitude and phase were measured, and FROG was applied to the compression of amplified continuum pulses.
**Sandia National Laboratories. **University of Michigan.*

9:15
H2 3 WH3 **Improved, robust algorithm for frequency-resolved optical gating measurements of ultrashort laser pulses,** Kenneth W. DeLong, David N. Fittinghoff, Celso L. Ladera, Rick Trebino, *Combustion Research Facility, Sandia National Laboratories, MS 9051, P.O. Box 969, Livermore, CA 94551-0969.* An improved, robust algorithm for reconstructing the amplitude and phase of ultrashort optical pulses from frequency-resolved optical gating measurements (FROG) are presented. While previous algorithms are occasionally unreliable, especially for second-harmonic generation FROG, the new algorithm, which now incorporates generalized projections, accurately reconstructs even very complex pulses.

9:30
H2 4 WH4 **The effects of noise in frequency-resolved optical gating measurements of ultrashort laser pulses,** Kenneth W. DeLong, David N. Fittinghoff, Celso L. Ladera, Rick Trebino, *Combustion Research Facility, Sandia National Laboratories, MS 9051, P.O. Box 969, Livermore, CA 94551-0969.* Frequency-resolved optical gating (FROG) techniques rely on phase retrieval algorithms to reconstruct the amplitude and phase of ultrashort optical pulses. Noise simulations that show that FROG reconstruction algorithms, unlike standard phase retrieval algorithms which can be unstable in the presence of noises, are remarkably robust to noise are presented.

9:45
H2 5 WH5 **Ultrafast temporal behavior of laser action of dyes in sand-like powders,** Masood Siddique, Q. Z. Wang, C. H. Liu, Robert R. Alfano, *Institute for Ultrafast Spectroscopy and Lasers, The City College of New York of The City University of New York, New York, NY 10031. E-mail: siddiq@scisun.sci.ccny.cuny.edu.* Laser action has been observed in optically-pumped dyes in wet and dry powders. Powders of assorted grain sizes of Al_2O_3, SiO_2, $MgCO_3$, and TiO_2 were used. A 30-ps Nd:YAG laser @ 532 nm was used as the pump beam. The emission output was temporally and spectrally resolved with a streak camera and a spectrometer. The type, size, and concentration of the powders, and the threshold of pure dye solution influenced the threshold of the laser action and output wavelength. Some powders demonstrated laser action below the sensitivity and temporal resolution limit of the detection system.

10:00
H2 6 WH6 **Laser action of Rh640 in scattering particle-suspension media,** W. L. Sha, C. H. Liu, R. R. Alfano, *New York State Center for Advanced Technology for Ultrafast Photonic Material and Applications, Institute for Ultrafast Spectroscopy and Lasers, Departments of Physics and Electrical Engineering, The City College and Graduate School of The City University of New York, New York, NY 10031. Net: weili@scisun.sci.ccny.cuny.edu.* Laser action of Rhodamine 640 perchlorate in scattering media consisting of different types and concentrations of TiO_2 particles in methanol is reported using the spectral and temporal measurements pumped by a 3-ns at 530-nm laser pulse. The threshold with and without particles is depended on the concentration of laser dye, coated and uncoated particles. The threshold was found to be reduced by over one to two orders of magnitude for 1.0×10^{-3}M to 2.5×10^{-2}M laser dye with particles in the regime of 5×10^{9} to $2.5\times10^{12}/cm^3$, respectively. The pulse duration of laser action for laser dye was on the order of 100 ps. For 10^{-4}M of Rh640 the threshold was higher for laser action in different diffusive media in comparison to the pure methanol liquid host.

10:15
H2 7 WH7 **Single-shot intensity and phase measurements of the frequency-doubled output from an ultrashort pulse Ti:sapphire laser system using self-diffraction frequency-resolved optical gating,** Tracy Sharp Clement, Daniel J. Kane,* K. W. DeLong,** Rick Trebino,** A. J. Taylor, *Los Alamos National Laboratory, MS E525, Los Alamos, NM 87545. E-mail: tracyc@lanl.gov.* Using single-shot self-diffraction frequency-resolved optical gating (FROG), the complete intensity and phase of the second-harmonic output at 405 nm from an amplified Ti:sapphire laser system is measured. Effects of compressor alignment are studied. Residual chirp in the pulses is clearly visible in the FROG traces.
**Southwest Sciences, Inc. **Sandia National Laboratories.*

SESSION H3 [WI]: JOINT SYMPOSIUM ON SPECTROSCOPIC APPLICATIONS FOR ENVIRONMENTAL STUDIES: ATMOSPHERIC TRACE GASES AND INDUSTRIAL APPLICATIONS

Wednesday morning, 5 October 1994
Loews Anatole Hotel
Sapphire Room at 8:30
Andrzej W. Miziolek, presiding

8:30
H3 1 WI1 (Invited) **Tunable IR laser differential absorption of atmospheric trace gases,** Mark S. Zahniser, David D. Nelson, J. Barry McManus, Paul L. Kebabian, Joda C. Wormhoudt, Joanne H. Shorter, Charles E. Kolb, *Aerodyne Research, Inc., 45 Manning Road, Billerica, MA 01821. Internet: mz@aerodyne.com.* IR absorption using tunable laser light sources in the 3 to 12 μm spectral region provides a sensitive and selective method for monitoring trace constituents in the atmosphere. Recent advances in multiple pass mirror designs, computerized data acquisition, and the development of rare gas laser light sources are discussed. Applications include measurements or greenhouse-source gas fluxes (CH_4 and N_2O), acidic trace gases (HCI, HOCI, HNO_3), and open path measurements of automobile tailpipe emissions (NO).

9:00
H3 2 WI2 **Helium spectroscopy with an InGaAs DBR laser diode,** Christopher L. Bohler, *Texas Instruments Inc., 2501 W. University, MS 8051, McKinney, TX 75070. I: drcb@timsg.csc.ti.com.* A highly stable, single-mode InGaAs DBR laser diode operating at 1083 nm has been employed for spectroscopic measurements in gaseous 3He and 4He. The characteristics of the laser source, results of absorption spectroscopy measurements, and potential applications are discussed.

9:15
H3 3 WI3 **Diode-laser-based instrumentation for trace gas detection and industrial applications,** D. S. Bomse, D. C. Hovde, D. J. Kane, D. B. Oh, J. A. Silver, A. C. Stanton, *Southwest Sciences, Inc., 1570 Pacheco Street, Ste. E-11, Santa Fe, NM 87505. E-mail: davidbomse@delphi.com.* High-frequency wavelength modulation spectroscopy using near-IR and near-visible diode lasers provides detection of

trace gases at sub-ppm concentrations. Demonstrated applications include airborne hygrometers, a methane fluxmeter, and perimeter monitoring. The fiber-optic compatible lasers allow rugged, portable, high performance instrumentation.

9:30
H3 4 WI4 **Linewidth measurement using two-tone frequency modulation spectroscopy,** W. H. Tam, H. C. Sun, S. McGuire, C. K. Ng, E. A. Whittaker, *Department of Physics and Engineering Physics, Stevens Institute of Technology, Hoboken, NJ 07030. I: ewhittak@vaxc.stevens-tech.edu.* In two-tone frequency modulation, molecular absorption is detected by modulating a laser at two distinct radio-frequencies and demodulating at the smaller frequency. The signal is a function of the linewidth-to-larger modulation frequency ratio and may be used to accurately measure the temperature of Doppler-broadened gases.

10:00
H3 5 WI5 **LIF measurement of Mn, MnO, and reactive-free radicals in flames,** Christopher R. Mahon, Gregory P. Smith, Jay B. Jeffries, David R. Crosley, Ulf Westblom,* Felix Fernandex-Alonso,** *Molecular Physics Laboratory, SRI International, Menlo Park, CA 94025. E-mail: Jeffries@MPLVAX.sri.com.* Laser-induced fluorescence measurements in low-pressure propane/air flames showed that a Mn fuel additive does not alter gas-phase prompt NO formation. Mn was measured using LIF and a simple atomic emission monitoring scheme. MnO LIF measurements revealed the existence of this compound early in the flame zone.
*Coherent Radiation. **Hamilton College.

SESSION PL43 [WS]: ILS PLENARY: 3
Wednesday afternoon, 5 October 1994
Loews Anatole Hotel
Wedgwood Room at 13:00
Paul L. Houston, presiding

13:00
PL43 1 WS1 (Plenary) **Applications of optical trapping to single molecule experiments,** Steven Chu, *Stanford University, Stanford CA 94305.* The ability to manipulate atoms and micro-sized particles with light coupled with recent advances in fluorescence microscopy have enabled us to examine a number of questions in both polymer physics and biology. Studies of polymer dynamics, specfically the study of dynamical scaling in dilute solution and the direct observation of reptation (snake-like motion) in polymer melts are described. The experiments to measure the motion of enzymes along a single molecule of DNA are also discussed.

SESSION I'1 [WCC]: JOINT SYMPOSIUM ON COHERENT PHENOMENA IN CHEMISTRY AND PHYSICS; APPLICATIONS OF PULSE-SHAPING TECHNOLOGY
Wednesday afteroon, 5 October 1994
Loews Anatole Hotel
Senators Lecture Hall at 14:00
Andrew M. Weiner, presiding

14:00
I'1 1 WCC1 (Invited) **Coherent control of exciton wavepackets in quantum wells,** Martin C. Nuss, *AT&T Bell Laboratories, 101 Crawfords Corner Road, Holmdel, NJ 07733-3030. E-mail: nuss@spin.ho.att.com.* Excitonic wavepacket oscillations in quantum wells emit electromagnetic dipole radiation at THz frequencies. Because of the picosecond dephasing times of excitons, these wavepacket oscillations and hence the THz emission can be optically controlled using appropriately-phased laser pulse sequences. Phase changes in the THz radiation of ±330 fs is achieved with an optical phase change of only 1.3 fs.

14:30
I'1 2 WCC2 (Invited) **Automated femtosecond pulse shaping and multiple-pulse femtosecond spectroscopy,** Marc M. Wefers, Hitoshi Kawashima, Weining Wang, Keith A. Nelson, *Department of Chemistry, Massachusetts Institute of Technology, Room 2-052, 77 Massachusetts Ave., Cambridge, MA 02139. E-mail: mwefers@athena.mit.edu.* Recent progress on the generation, characterization, and amplification of shaped ultrashort optical waveforms and their utility in femtosecond spectroscopy is presented. Prototype experiments on molecules and condensed materials, involving control over optical phase and amplitude profiles are discussed.

15:00
I'1 3 WCC3 **Digital signal filtering with femtosecond pulses,** V. Narayan, E. M. Dowling, D. L. MacFarlane, *The University of Texas at Dallas, Richardson, TX 75083. E-mail: dlm@utdallas.edu.* Optical lattice filters are used to perform digital signal processing at very high clock rates. This experimental and theoretical talk describes the design of these coherent and incoherent structures, with such limiting factors as losses and finite word length. Practical functions include discrete time integrators and correlators.

15:15
I'1 4 WCC4 **Transverse and temporal beam encoding using bulk CdTe,** Abdulatif Y. Hamad, Steve Y. Wang,* James P. Wicksted, *Department of Physics, Center for Laser Research, Oklahoma State University, Stillwater, OK 74078. E-mail: JPW519@vms.ucc.okstate.edu.* A theory has been developed to model the spatial and temporal profiles of nanosecond laser pulses transmitted through CdTe crystals. A phase shift encoded to the beam was found to be the cause of the pulse reshaping. The nonlinear parameters deduced from the fitting are in good agreement with previous experimental and theoretical results.
*Tamkang University.

SESSION I'2 [WDD]: SYMPOSIUM ON PARTICLE BEAM-PUMPED LASERS
Wednesday afternoon, 5 October 1994
Loews Anatole Hotel
Topaz Room at 14:00
Daniel Murnick, presiding

14:00
I'2 1 WDD1 (Invited) **Heavy ion accelerator beam-pumped lasers,** A. Ulrich, *Fakultät für Physik E 12, James-Franck-Str. 1, D-85747 Garching, Germany. Internet: ulrich@physik.tu-muenchen.de.* Excitation of matter with high-energy heavy-ion beams leads to a unique plasma in which collisional ionization forms multiply ionized species in a cold, dense environment. Charge transfer and excimer formation are the dominant processes in such a plasma. Laser-pumping schemes based on these processes are discussed.

14:30
I'2 2 WDD2 (Invited) **Modeling of high pressure rare gas lasers: kinetics and plasma chemistry,** Jong W. Shon, *Sandia National Laboratories, P.O. Box 969, MS 9043, Livermore, CA 94551-0969. E-mail: jwshon@california.sandia.gov.* Three rare gas (Ar, Ne, Xe) lasers have been investigated using a computer model to understand their excitation and deexcitation mechanisms and to optimize the laser performance over the wide range of operating parameters: gas mixture, pressure, and power and energy deposition.

15:00
I'2 3 WDD3 (Invited) Fission-fragment pumped lasers, G. A. Hebner, *Sandia National Laboratories, Dept. 1128, MS 0601, Albuquerque, NM 87185. Internet: gahebne@sandia.gov.* Nuclear-pumped lasers can potentially be scaled to multi-megawatt power levels with long run times. Power efficiency, small signal gain, and saturation intensity have been measured for a number of visible and near-IR laser transitions in atomic neon, argon, and xenon. An overview of this investigation is presented.

SESSION I'3 [WEE]: JOINT SYMPOSIUM ON SPECTROSCOPIC APPLICATIONS FOR ENVIRONMENTAL STUDIES: THE USE OF LIDAR FOR ATMOSPHERIC AND ENVIRONMENTAL MEASUREMENTS: 1

Wednesday afternoon, 5 October 1994
Loews Anatole Hotel
Sapphire Room at 14:00
Marshall Lapp, presiding

14:00
I'3 1 WEE1 (Invited) Recent lidar studies: from gravity waves in the mesosphere to hydrography in the ocean, Allan I. Carswell, *Institute for Space and Terrestrial Science and the Department of Physics and Astronomy, York University, 4700 Keele Street, North York, Ontario, Canada, M3J 1P3. Internet: fs300015@sol.yorku.ca.* Lidar applications now span the spectrum from research investigations to routine operations. This is illustrated by studies at York University which have led to the development of ground-based lidar systems for investigating the structure and composition of the atmosphere and airborne lidars for operational water depth sounding.

14:30
I'3 2 WEE2 (Invited) Spatial properties of the atmospheric boundary layer as observed by lidar, Daniel I. Cooper, William Eichinger, Charles Lebeda, David Poling, *GEONET Program, Los Alamos National Laboratory, MS D436, Los Alamos, NM 87545.* Recent advances in volume-imaging lidars allow spatially-dynamic processes within the atmospheric boundary layer (ABL) to be mapped. Convection and other intermittent events are spatially discrete phenomenon that have not been adequately mapped due to the lack of appropriate instrumentation. We have shown that there are atmospheric features which can only be understood with the aid of scanning lidars.

SESSION I'4 [WFF]: SYMPOSIUM ON OPTICAL TWEEZERS

Wednesday afternoon, 5 October 1994
Loews Anatole Hotel
Wedgwood Room at 14:00
Steven Chu, presiding

14:00
I'4 1 WFF1 (Invited) Optical force microscope, Lucien P. Ghislain, Watt W. Webb, *School of Applied and Engineering Physics, Cornell University, Ithaca, NY 14853. I: luc@msc.cornell.edu.* The optical trap formed by a strongly-focused laser beam can be utilized as the force-sensing element of a novel scanning probe microscope. In the optical force microscope (OFM) the deflection of an optically-trapped probe, such as a micron-diameter polystyrene sphere, is monitored while scanning over a sample surface.

14:30
I'4 2 WFF2 (Invited) Optical tweezers study of muscle contraction at the molecular level, Jeffrey T. Finer, Robert M. Simmons,* James A. Spudich, *Department of Biochemistry, Stanford University, Stanford, CA 94305. E-mail: finer@cmgm.stanford.edu.* Optical tweezers have recently become valuable tools for the study of biological motors, such as myosin, which powers muscle contraction. Micron-sized beads held in the laser focus are coupled to the interacting proteins to serve as force transducers and as probes for motion. Direct measurements of the motion and force produced by single molecules are presented.
**King's College London, UK.*

SESSION J1 [WMM]: JOINT SYMPOSIUM ON SHAPING AND PROCESSING OF ULTRASHORT OPTICAL PULSES

Wednesday afternoon, 5 October 1994
Loews Anatole Hotel
Senators Lecture Hall at 15:30
Andrew M. Weiner, presiding

15:30
J1 1 WMM1 (Invited) Distributed Bragg pulse shapers, David Brady, *Department of Electrical and Computer Engineering, Beckman Institute, University of Illinois at Urbana-Champaign, Urbana, IL 61801.* Reflection geometry diffractive structures for pulse train and pulsed-image encoding are described. The potential for high speed pulse shaping using electro-optic modulation of Bragg gratings in waveguides is considered and potential applications in communications and nonlinear dynamics are discussed.

16:00
J1 2 WMM2 (Invited) Temporal imaging of ultrafast waveforms, Brian H. Kolner, *Electrical Engineering Department, University of California-Los Angeles, 405 Hilgard Avenue, Los Angeles, CA 90024-1594. E-mail: kolner@ee.ucla.edu.* We have developed a temporal imaging system based on the space-time duality between diffraction and dispersion in conjunction with a time lens. Applications include temporal microscopy (magnification) and demagnification of arbitrarily shaped ultrafast waveforms, pulse compression, data multiplexing, and signal processing.

J1 3 WMM3 Paper withdrawn.

16:30
J1 4 WMM4 New techniques of ultrashort pulse-shape reconstruction from frequency-domain measurement, Victor Wong, Ian A. Walmsley, Ken W. DeLong,* Rick Trebino,* *The Institute of Optics, University of Rochester, Rochester, NY 14627. E-mail: vwong.optics.optics.rochester.edu.* Two new techniques are applied to reconstruct the temporal shape of ultrashort pulses using the complete cross-correlation data measured in the frequency-domain: an iterative 2D phase-retrieval algorithm and a direct de-cross-correlation procedure.
**Sandia National Laboratories.*

16:45
J1 5 WMM5 Parametric amplification of ultrashort pulses in $Al_xGa_{1-x}As$ waveguides, R. P. Espindola, D. Y. Chu, S. L. Wu, M. K. Udo, S. T. Ho, *Department of Electrical Engineering and Computer Science, Northwestern University, 2145 Sheridan Road, Evanston, IL 60208. E-mail: sth@eecs.nwu.edu.* Broadband parametric amplifiers can be used to amplify and shape ultrashort optical pulses. A single-pass pulse-delayed scheme to achieve optical parametric amplification at 1.55 to 1.60μm in $Al_xGa_{1-x}As$ waveguides is described. This scheme allows us to conveniently separate the pump pulses from the amplified signal pulses.

17:00
J1 6 WMM6 **Multiple scattered light in random media in the presence of metallic particles**, Margarita Mihailidi, Q. Z. Wang, R. R. Alfano, *Institute for Ultrafast Spectroscopy and Lasers, The City College and the Graduate Center of the City University of New York, Convent Avenue & 138th Street, New York, NY 10031. E-mail: eemmm@eesiso.emgr.ccny.edu.* The temporal profile of light passing through dielectric random media with scatterer size < λ is measured. The effect of adding metal particles which alter the temporal profile is investigated. Attenuation of the scattered light that arrives at later times is achieved, thus reducing the diffusive noise component of the signal.

SESSION J2 [WNN]: JOINT SYMPOSIUM ON ULTRASHORT PULSE FIBER LASERS

Wednesday afternoon, 5 October 1994
Loews Anatole Hotel
Topaz Room at 15:30
David Richardson, presiding

15:30
J2 1 WNN1 (Invited) **Femtosecond fiber lasers**, Kohichi R. Tamura, Hermann A. Haus, Erich P. Ippen, *Massachusetts Institute of Technology, 77 Massachusetts Ave., 36-355, Cambridge, MA 02139. E-mail: krtamura@mit.edu.* Passively-mode-locked erbium-doped fiber lasers are of interest as compact sources of ultrashort pulses in the 1.5-μm wavelength region. The lasers may be operated in the soliton and nonsoliton regimes. Design issues for optimizing performance in both regimes are discussed.

16:00
J2 2 WNN2 **Modified harmonically-mode-locked lasers and applications**, R. L. Fork, K. Singh, J. Haus, W. Kaechele, M. Nielsen, R. K. Erdmann,* S. T. Johns,* *Department of Physics, Rensselaer Polytechnic Institute, Troy, NY 12180. E-mail: forkr@rpi.edu.* Experiments on a harmonically-mode-locked laser, and numerical simulations of that laser are used to examine generation of stable synchronized trains of ultrashort solitons at gigahertz repetition rates. We find fast Kerr-effect saturable absorbers introduced in the laser so as to introduce minimum additional length, have special advantages.
Griffiss Air Force Base.

16:15
J2 3 WNN3 **Propagation of Raman solitons in inhomogeneously-broadened media**, Arthur R. Luimes, *Maharishi International Univeristy, 1000 North 4th Street, FB-1069, Fairfield, IA 52557-1069. E-mail: physgrad@physics.miu.edu.* In homogeneously-broadened media, Raman solitons decay rapidly for detuning from resonance. For inhomogeneous broadening, we find that solitons are stable to first-order in the linewidth. This suggests the possibility of ultrashort pulse generation in fibers through Raman solitons. Computer simulations confirm the predicted soliton stability.

16:30
J2 4 WNN4 **Generation of ultrashort pulses through Raman solitons**, Kai J. Drühl, *Maharishi International Univeristy, 1000 North 4th Street, FB-1074, Fairfield, IA 52557-1074. E-mail: druhl@physics.miu.edu.* Solitons in stimulated Raman scattering are generated by a phase shift in the Stokes beam. Raman solitons generated by a fixed phase shift in the Stokes beam will decay rapidly if pump and Stokes are not exactly on resonance. We find that Raman solitons remain stable if the phase shift is allowed to depend on the frequency offset. Ultrashort pulses are generated in this way.

16:45
J2 5 WNN5 **Dynamics and statistics of the Stokes pulse formation during stimulated Raman scattering in optical fibers**, Clifford Headley, III, Govind P. Agrawal, *The Institute of Optics, University of Rochester, Rochester, NY 14627. E-mail: headley@optics.rochester.edu.* A numerical model that includes noise initiation through a Langevin source, and the exact gain and phase index effects by using the experimentally obtained Raman gain spectrum, is used to study the statistical features of stimulated Raman scattering in fibers.

17:00
J2 6 WNN6 **Soliton generation in the normal dispersion regime from a continuously frequency-shifted fiber laser**, M. Romagnoli, S. Wabnitz, P. Franco,* M. Midrio,* F. Fontana,** *Fondazione U. Bordoni, V.B. Castiglione 59, 00142 Rome, Italy.* Theoretical and experimental studies of the generation of high-repetition-rate picosecond solitary pulses from a continuously frequency-shifted fiber-ring laser. The interplay of bandwidth limited amplification, self-phase modulation, normal group velocity dispersion, nonlinear polarization rotation, and frequency shifting lead to a stable and tunable source of chirped pulses.
*University of Padova. **Pirelli Cavi.*

17:15
J2 7 WNN7 **Figure-eight laser simulation**, J. Theimer, J. W. Haus, R. L. Fork, *Department of Physics, Rensselaer Polytechnic Institute, Troy, NY 12180. E-mail: hausjj@rpi.edu.* The effect of Raman shift, self-steepening, and third-order dispersion is examined for the figure-eight laser with a nonlinear optical loop mirror. Our model includes saturation and gain dispersion in the amplifier. Laser design optimization for the production of short pulses is considered.

SESSION J3 [WOO]: JOINT SYMPOSIUM ON SPECTROSCOPIC APPLICATIONS FOR ENVIRONMENTAL STUDIES: THE USE OF LIDAR FOR ATMOSPHERIC AND ENVIRONMENTAL MEASUREMENTS: 2

Wednesday afternoon, 5 October 1994
Loews Anatole Hotel
Sapphire Room at 15:30
Marshall Lapp, presiding

15:30
J3 1 WOO1 **Lidar for stratospheric aerosol and temperature measurements**, J. B. Nee, P. C. Lee, S. B. Lin, *Department of Physics, National Central University, Chung-Li, Taiwan, 320, ROC. Internet: JBNEE@PHYAST.DNET.NCU.EDU.TW.* A Mie/Rayleigh lidar system for stratospheric aerosol and temperature measurements has been installed at the National Central University in Taiwan. This lidar system consists of a YAG laser at 532 nm as the transmitter and a Newtonian telescope of 18" diameter as the receiver. The stratospheric aerosol and temperature were measured routinely. Results from the first year observations are reported.

15:45
J3 2 WOO2 **Overview of backscatter absorption gas imaging (BAGI)**, Thomas J. Kulp, *Sandia National Laboratories, Livermore, CA 94550.* Backscatter absorption gas imaging (BAGI) is a relatively new laser remote-sensing technique that allows real-time video images of gas plumes to be made. Its development has been motivated by the need for an efficient means of both detecting and locating the sources of gas leaks. Leak location with an imaging device is vastly superior in efficiency to the use of point-sensing "sniffer" type detectors. BAGI operates by illuminating a scene with laser radiation having a wavelength

that is absorbed by the gas to be detected. Simultaneously, the scene is imaged by a video camera that is compatible with that wavelength. If present in the scene, the target gas will absorb the laser radiation and appear as a dark cloud in the video picture. An overview of the signal modeling and the performance of these devices is presented. The potential for development of other types of imagers operating in other wavelength ranges is discussed, as well as the status of current BAGI research at SNL. *Work performed under the sponsorship of the U.S. Navy, Naval Sea Systems Command (NAVSEA-OOC).*

16:00
J3 3 WOO3 (Invited) New methods for chemical analysis by ultraviolet fluorescence lidar, Philip J. Hargis, Jr., John S. Wagner, *Sandia National Laboratories, Lasers, Optics and Remote Sensing, Department 1128, Albuquerque, NM 87185-0601. E-mail: pjhargi@sandia.gov.* New chemical analysis methods that provide a general survey of species in remote sensing applications, such as waste-site characterization and air-quality monitoring, are described. The methods use a unique multivariate analysis algorithm to determine species concentrations from multiwavelength ultraviolet fluorescence lidar measurements.

16:15
J3 4 WOO4 Air monitoring by line- and continuously-tunable CO_2 laser photoacoustic systems, Markus W. Sigrist, Philippe Repond, Marc A. Moeckli, Andreas Thöny, *Swiss Federal Institute of Technology (ETH), Institute of Quantum Electronics, CH - 8093 Zurich, Switzerland. I: sigrist@iqe.phys.ethz.ch.* A homebuilt, mobile CO_2 - laser photoacoustic (PA) system has been successfully applied to trace gas monitoring in ambient air and industrial emissions.[1] We developed a novel PA instrument with a high pressure CO_2 laser that is continuously tunable across wavelength ranges of 15.8 to 21.6 cm^{-1} with a bandwidth of 0,017 cm^{-1}. Laboratory measurements on trace gas mixtures demonstrate the excellent detection selectivity.

1. M. W. Sigrist, ed., *Air Monitoring by Spectroscopic Techniques*, Chem. Analysis Series, **127**, Wiley (New York, 1994).

16:30
J3 5 WOO5 Atmospheric properties measurements and data collection from a hot air balloon, Steven M. Watson, Robert T. Kroutil,* Trevor Spencer,** Colin Flyn,** Robert Eason,*** Timothy Holloway,** Gary Lumsdon,**** Pierre Sokolski,***** Stan Thomas,***** Ken C. Herr,****** Jeff L. Hall,****** G.J. Schere,****** and M.L. Polak,****** *U.S. Air Force, 5948 Southgate Ave., Hill AFB, UT 84056.* Manned hot air balloons have been demonstrated as platforms for various atmospheric measurements and remote sensing tasks. The equipment operated and tested on the balloons includes various remote sensing equipment such as FTIR spectrometers, IR cameras, a FLIR system, high resolution CCD cameras and atmospheric transmission and laser image profiles through different slant paths, characterized chemical plumes being emitted from real and simulated industrial stacks, and collected UV-scattering absorption data.

**U.S. Army. **Defence Research Agency, UK. ***Ministry of Defence, UK. ****Institute of Aviation Medicine (Royal Air Force), UK. *****University of Utah. ******The Aerospace Corporation.*

16:45
J3 6 WOO6 The airborne Raman lidar, Wm. S. Heaps, John F. Burris, *Laboratory for Atmospheres, NASA Goddard Space Flight Center, Greenbelt, MD 20771. Internet: heaps@oz.gsfc.nasa.gov.* Recent flight tests of the airborne Raman lidar aboard a NASA C-130 aircraft were completed on April 9, 1994. Measurements of methane, water vapor, temperature, and pressure were obtained. Future enhancements and operational plans for the instrument are described.

17:00
J3 7 WOO7 Laser diode fiber-optic methane sensor for offshore gas rigs, Antonio Lancia, Giacomo Fusina, Arman Mohebati,**TRI srl - Via A. Moro, 1-24020 Scanzorosciate (BG), Italy. E-mail: tri.srl@galactica.it.* An extrinsic fiber-optic multiplexed sensor for methane with open path cells was developed based on laser absorption spectrometry. Source is a quaternary structure 1.3-micron multimode diode laser. The system is presented together with data from its installation on an off-shore gas rig. Comparison is made with conventional technology.

**Vuman Lasers Ltd., England.*

17:15
J3 8 WOO8 Pulsed photothermal deflection spectroscopy in a solid sample, George L. Bennis, Reeta Vyas, R. Gupta, *Department of Physics, University of Arkansas, Fayetteville, AR 72701. I: RG24627@UAFSYSB.UARK.EDU.* The theory of photothermal deflection spectroscopy in a solid sample deposited on a transparent substrate, heated by means of a pulsed-pump laser is considered. The temperature profile is derived, from which the deflection of a probe-beam passing transverse and near the sample surface is calculated.

SESSION J4 [WPP]: JOINT SYMPOSIUM ON MANIPULATION OF ATOMS BY LIGHT: TRAPPING AND COOLING
Wednesday afternoon, 5 October 1994
Loews Anatole Hotel
Wedgwood Room at 15:30
Alain Aspect, presiding

15:30
J4 1 WPP1 (Invited) A gravitational cavity for atoms, C. Aminoff, P. Bouyer, C. Cohen-Tannoudji, J. Dalibard, P. Desbiolles, A. Steane, P. Szriftgiser, *Laboratoire Kastler Brossel, Ecole Normale Supérieure, 24 rue Lhomond, 75005 Paris, France. E-mail: dalibard@physique.ens.fr.* Recent experimental results concerning the stable confinement of Cs atoms in a gravitational cavity, involving a single curved mirror are presented. Some prospects opened in the domain of atomic interfometry using a "time modulated mirror" are discussed.

16:00
J4 2 WPP2 Magneto-optic trap for radioactive rubidium and francium, G. Gwinner, J. A. Behr, S. B. Cahn, A. Ghosh, L. A. Orozco, G. D. Sprouse, J. Urayama, F. Xu, *Department of Physics, SUNY at Stony Brook, Stony Brook, NY 11794-0001. E-mail: gwinner@sbnsld.physics.sunysb.edu.* A magneto-optic trap in a vapor cell was developed to trap small quantities of radioactive rubidium and francium efficiently. We have trapped about 80 ^{79}Rb atoms (half-life 22 min.). Progress towards capturing francium is reported.

16:15
J4 3 WPP3 Transfer of laser-cooled atoms into a magnetic trap, Kendall B. Davis, Marc-Oliver Mewes, Michael R. Andrews, Wolfgang Ketterle, *Atomic Physics, Massachusetts Institute of Technology, Cambridge, MA 02139-4307. E-mail: mom@amo.mit.edu.* The transfer of sub-Doppler cooled sodium atoms into a magnetic trap has been studied. By varying the magnetic field strength this transfer was optimized to preserve phase-space density. This optimization has yielded densities of 10^{11} atoms/cm^3 at a temperature of 60 μK which should be sufficient for cooling by evaporation.

16:30
J4 4 WPP4 A spin-flip Zeeman slower for the production of intense slow sodium beams, Marc-Oliver Mewes, Kendall B. Davis, Peter Yesley, Michael A. Joffe, David E. Pritchard, Wolfgang Ketterle, *Atomic Physics, Massachusetts Institute of Technology, Cambridge, MA*

02139-4307. E-mail: mom@amo.mit.edu. A novel Zeeman slower for sodium atoms in which the longitudinal magnetic field changes direction has been demonstrated. This design produces a high flux of slow atoms by optically pumping atoms between hyperfine states. A loading rate into a magneto-optical trap of 10^{12} atoms/s is expected.

16:45
J4 5 **WPP5 Observation of dynamical localization in atomic momentum transfer,** F. L. Moore, J. C. Robinson, C. Bharucha, M. G. Raizen, *Department of Physics, University of Texas at Austin, Austin, TX 78712. E-mail: Raizen@utaphy.ph.utexas.edu.* The observation of dynamical localization in the atomic momentum transfer from a modulated standing wave of light is reported, and our results are compared with theoretical predictions. This system is a direct realization of the periodically-driven rotor, and can serve as a testing ground for many predictions in quantum chaos.

17:00
J4 6 **WPP6 Resonance fluorescence, gain, and momentum diffusion of atoms moving in standing waves of optical fields,** M. S. Shahriar, T. W. Lynn,* D. P. Katz,* M. G. Prentiss,* P. R. Hemmer,** *Research Laboratory of Electronics, Massachusetts Institute of Technology, Room 26-368, Cambridge, MA 02139, Internet: smshahri@athena.mit.edu.* A new formalism for computing two-time correlation functions of atomic operators using numerical integrations is presented. This method is used to compute resonance fluorescence, gain, and momentum diffusion of atoms moving in optical standing waves, yielding novel informations about rescattering-induced repulsion/attraction effects in traps of two- and three-level atoms.
**Harvard University. **Rome Laboratory, Hanscom Air Force Base.*

17:15
J4 7 **WPP7 The Jaynes-Cummings model with atomic recoil,** Eduardo J. D'Angelo, Lorenzo M. Narducci, Frank A. Narducci,* Ping Ru, Donna K. Bandy,** *Physics Department, Drexel University, Philadelphia, PA 19104. I: eduardo@wotan.physics.drexel.edu.* A generalization of the traditional Jaynes-Cummings model with the inclusion of the atomic translational motion is considered. We derive analytic expressions for the dressed states and corresponding energies of the coupled-atom field system, and study the evolution of a number of initial configurations. We generalize our description to include multilevel atoms.
**University of Rochester. **Oklahoma State University.*

SESSION K'10 [WXX]: ILS POSTER SESSION: 2
Wednesday afternoon, 5 October 1994
Loews Anatole Hotel
Trinity Hall at 17:30

K'10 1 **WXX1 Novel intermodal coupling in semiconductor lasers by phase-conjugate optical feedback,** George R. Gray, Govind P. Agrawal,* *Department of Electrical Engineering, University of Utah, 3280 Merrill Engineering Building, Salt Lake City, UT 84112. I: gray@ee.utah.edu.* Phase-conjugate feedback in multimode semiconductor lasers provides a novel intermodal coupling which is not present with conventional feedback. Pairs of modes are directly coupled as a result of the optical feedback. The potential applications of this coupling mechanism to mode-locking are explored.
**University of Rochester.*

K'10 2 **WXX2 Low-phase dispersion measurements of laser cavity components by spectrophotometric resonating technique,** Michael A. Bukhshtab, *Accurate Optical Measurements Co., 7325-D Mahaffey Drive, New Port Richey, FL 34653.* A method of resonance reflection measurements, determining a phase dispersion character of laser cavity mirrors and output couplers for ultrafast lasers, is proposed. A key element of the technique is based on the ability to distinguish a multiple reflection interference factor over a low transmission extent of an output coupler. Obtained results are mostly contrasting by more detailed phase spectrums than theretically estimated.

K'10 3 **WXX3 Phase dynamics in nanosecond pulsed-dye amplification,** N. Melikechi, S. Gangopadhyay, E. E. Eyler, *Department of Physics and Astronomy, University of Delaware, Newark, DE 19716. I: gwi05903@udelvm.udcl.edu.* We have devised a model for optical phase distortions introduced by pulsed laser amplification, and tested it experimentally for an amplifier using DCM dye. The laser frequency is shifted and chirped primarily by time-dependent changes in the refractive index, caused by the varying excited-state population density of the dye.
Supported by the National Science Foundation.

K'10 4 **WXX4 An optimization in differential thermal lens technique for studying nonlinear absorption,** A. Marcano, O. J. Castillo,* V. Kozich,** E. Hernand,* *Centro de Física, Instituto Venezolano de Investigaciones Científicas, Caracas 1020A, Apartado 21827, Venezuela.* Dual beam differential thermal lensing is developed to observe heating resulting from the two-photon light absorption by dissolved molecules without thermal contribution due to linear absorption in solvent. The signal optimization is reached by changing sizes and positions of pump and probe beams waists.
**Universidad Central de Venezuela. **Academy of Sciences of Belarus.*

K'10 5 **WXX5 Spectroscopic characterization of Nd:S-VAP,** Dhiraj K. Sardar, Peter D. Bella, *Division of Earth and Physical Sciences, University of Texas at San Antonio, 6900 North Loop 1604 West, San Antonio, TX 78249-0663. E-mail: dsardar@pclen.utsa.edu.* A spectroscopic investigation of Nd^{3+}: $Sr_5(VO_4)_3F$ (Nd:S-VAP) has been performed. The Judd-Ofelt theory was applied to the absorption spectra of Nd^{3+} $4f^3$ transitions to determine the orientation-averaged crystal intensity parameters: $\Omega_2 = 9.14\times10^{-20}$ cm^2, $\Omega_4 = 5.92\times10^{-20}$ cm^2, $\Omega_6 = 2.03\times10^{-20}$ cm^2. These parameters were then used to determine the emission probabilities of transitions from the Nd^{3+} $^4F_{3/2}$ metastable state to the lower lying J manifolds and thier corresponding branching ratios, the radiative lifetime (248 μs) and quantum efficency (0.93) of the $^4F_{3/2}$ state. These values are compared with those of other common Nd-doped solid-state laser materials.
This work was supported by the NSF Grant DMR-9303448.

K'10 6 **WXX6 The optical nonlinearity of titanium and gold ion-implanted fused silica,** Z. Pan, S. H. Morgan, R. H. Magruder, III,* R. A. Zuhr,** *Physics Department, Fisk University, Nashville, TN 37208.* The strong optical nonlinearities of titanium and gold implanted fused silica are reported. The nonlinear optical refractive index and two-photon absorption coefficient of a Ti-implanted glass, an Au-implanted glass, and a Ti and Au co-implanted glass have been determined using the Z-scan technique.
**Vanderbilt University. **Oak Ridge National Laboratory.*

K'10 7 WXX7 Polycarbonate-based photorefractive materials, Ryszard Burzynski, Yue Zhang, Saswati Ghosal, *Laser Photonics Technology, Inc., 1576 Sweet Home Road, Amherst, NY 14228. E-mail: cheburzy@ubvm.cc.buffalo.edu.* A new class of polymeric photorefractive composites have been developed in which polycarbonate was doped with a hole-transporting agent, a photocharge sensitizer, and second-order chromophores such as NPP and PRODAN, which show no absorption at the operating wavelength. Holographic diffraction efficiencies as high as 15% have been obtained.

K'10 8 WXX8 Laser-induced photobleaching in γ-irradiated doped fluorite: fabrication of absorbing layers with variable transmission in visible and near-IR regions, Svetlana G. Lukishova, Ekaterina A. Magulariya,* *Institute of Radioengineering & Electronics of the Russian Academy of Sciences, Mokhovaya 11, Moscow 103907, Russia. E-mail: lab221@ire.uuco free.msk.su.* The kinetics of photobleaching of γ-irradiated doped fluorite under the irradiation of 0.248-0.53-μm lasers and fabrication of apertures with radially-variable transmission are considered.
**Moscow Institute of Physics & Technology.*

K'10 9 WXX9 Fokker-Planck equation for a single two-level atom inside a cavity, C. Wang, Reeta Vyas, *Department of Physics, University of Arkansas, Fayetteville, AR 72701. E-mail: RV24533@UAFSYSB.UARK.EDU.* An exact Fokker-Planck equation for a single two-level atom in an optical cavity driven by an external field is derived without making system size expansion and truncation. This equation offers an alternative method for studying quantum fluctuations of small optical systems involving a single two-level atom.

K'10 10 WXX10 Difference frequency generation in creation of a high-resolution mid-IR spectrophotometer and its use in the v_2 spectrum of $HCCN_4$, Wade C. Eckhoff, Charles E. Miller, Robert F. Curl, Frank K. Tittel, *Rice Quantum Institute, Rice University, P.O. Box 1892, Houston, TX 77251. Internet: wade@katzo.rice.edu.* Difference frequency generation with tunable visible lasers is being used to generate continuously tunable mid-IR light. Utilizing this technique, a high resolution spectrum of the v_2 spectrum of HCCN in the region of its CCN antisymmetric stretching fundamental has been measured.

K'10 11 WXX11 Optical parametric interaction in $Nd:MgO:LiNbO_3$, Narasimha S. Prasad, *Department of Electrical and Computer Engineering, New Mexico State University, Las Cruces, NM 88001. E-mail: nprasad@nmsu.edu.* Optical parametric interaction in 1064-nm pumped $Nd:MgO:LiNbO_3$ is reported. Under singly-resonant operation, the oscillation threshold was found to be 38 MW/cm². A peak conversion efficiency of 10% and a tuning range of 1500 nm to 3600 nm have been demonstrated.

SESSION PL44 [ThA]: ILS PLENARY: 4
Thursday morning, 6 October 1994
Loews Anatole Hotel
Wedgwood Room at 8:00
W. C. Lineberger, presiding

8:00
PL44 1 ThA1 (Plenary) Molecular hydrogen: investigating the spectroscopy, decay dynamics, and reactions of the excited states in the age of the laser, Patricia M. Dehmer, *Argonne National Laboratory, Bldg. 203 - Room B161, 9700 South Cass Avenue, Argonne, IL 60439. Bitnet: PMDehmer@anl.gov.* Although studied since the 1920s, it was not until relatively recently that experiment and theory combined to solve some of the mysteries of the high-lying states of this deceptively complex molecule. The role that modern laser physics is playing in this effort is examined.

SESSION L'3 [ThN]: SMALL MOLECULAR SPECTROSCOPY
Thursday morning, 6 October 1994
Loews Anatole Hotel
Sapphire Room at 9:00
C. S. Feigerle, presiding

9:00
L'3 1 ThN1 Multiple resonance spectroscopy of $^7Li_2$, K. Urbanski, A. Yiannopoulou, A. M. Lyyra, Li Li,* *Department of Physics, Temple University, Barton Hall 009-00, Philadelphia, PA 19122. E-mail: V1778G@VM.TEMPLE.EDU.* Using multiple resonance techniques, high rovibrational levels in the $A^1\Sigma_u^+$ and $F^1\Sigma_g^+$ have been observed. Molecules were excited using cw single-mode ring lasers. Levels in the $A^1\Sigma_u^+$ state were observed as dip signals in the collision induced side fluorescence. An ultrasensitive ionization detector was employed to observe high levels in the $F^1\Sigma_g^+$ state.
**Dalian Institute of Chemical Physics, China*

9:15
L'3 2 ThN2 High resolution cw multiphoton laser spectroscopy of high-lying Rydberg and doubly-excited states of $^7Li_2$, A. Yiannopoulou, B. Ji,* K. Urbanski, Li Li,** A. M. Lyyra, W. C. Stwalley,* *Department of Physics, Temple University, Barton Hall 009-00, Philadelphia, PA 19122. E-mail: v1509g@vm.temple.edu.* CW perturbation-facilitated optical-optical double resonance (PFOODR) has been used for the detection of the $2^3\Sigma_g^+$, $3^3\Sigma_g^+$, $3^3\Pi_g$, $4^3\Sigma_g^+$, $1^3\Delta_g$ Rydberg states and the $1^3\Sigma_g^-$, $2^3\Pi_g$ doubly-excited states of $^7Li_2$. By using single-mode dye lasers we have achieved high resolution and resolved the hyperfine structure of most of the triplet states.
**University of Connecticut. **Dalian Institute of Chemical Physics and Tsinghua University, China.*

9:30
L'3 3 ThN3 Quantum state selected photodissociation of K_2, B. Ji, W. C. Stwalley, P. D. Kleiber,* A. Yiannopoulou,** A. M. Lyyra,** *Physics Department, University of Connecticut, 2152 Hillside Road, Storrs, CT 06269.* Quantum state preparation and state-selected photodissociation of K_2 were studied by high-resolution cw all-optical triple-resonance spectroscopy using the B - X system. Polarization measurements determined the initial- and final-state alignment of the K_2 molecules and the K* fragment. An Adiabatic/Recoil model was applied to analyze the data.
**University of Iowa. **Temple University.*

9:45
L'3 4 ThN4 Rotationally-resolved excitation spectrum of Hg_2, W. Kedzierski, A. Czajkowski, J. Supronowicz, J. B. Atkinson, L. Krause, *Department of Physics, University of Windsor, Windsor, Ontario, Canada N9B 3P4.* The rotational analysis of an extensive excitation spectrum of the monoisotopic $^{202}Hg_2$ excimer is outlined, giving values of spectroscopic constants and bond lengths for the excited states. ^{202}Hg vapor in a quartz cell was subjected to pump and probe excitation which resulted in the emission of Hg_2 molecular fluorescence. The pump radiation, which consisted of frequency-doubled output from an Ar^+ laser, caused the formation of Hg_2 $AO_g^{\pm}$ excimers by photoassociation. Simultaneous probe radiation from a ring dye laser excited the $AO_g^{\pm}$ excimers to high rovibronic states which decayed to the

repulsive ground state emitting a structured continuum. Ring-laser scans produced an excitation spectrum with an extensive rotational structure whose analysis yielded spectroscopic constants and provided a check on calculated PE curves.

SESSION L'4 [ThO]: JOINT SYMPOSIUM ON MANIPULATION OF ATOMS WITH LIGHT: NANOKELVIN COOLING: 1
Thursday morning, 6 October 1994
Loews Anatole Hotel
Wedgwood Room at 9:00
W. D. Philips, presiding

9:00
L'4 1 ThO1 (Invited) Raman cooling below the recoil limit, Heun Jin Lee, Nir Davidson, C. S. Adams, Mark Kasevich, Steven Chu, *Department of Physics, Stanford University, Stanford, CA 94305-4060.* A new cooling scheme using stimulated Raman transitions and a far-detuned optical dipole force trap has attained effective temperatures below the photon recoil limit. Red and blue detuned traps are discussed.

9:30
L'4 2 ThO2 (Invited) Adiabatic cooling of atoms trapped in an optical lattice, R. J. C. Spreeuw, P. S. Jessen,* A. Kastberg,** W. D. Phillips,** S. L. Rolston,** *Fakultät für Physik, University of Konstanz, Postfach 5560, M696, D-78434 Konstanz, Germany. Internet: spreeuw@spock.physik.uni-konstanz.de.* 3D optical lattices[1-4] of Cs by an optical heterodyne technique and by time-of-flight temperature measurements were studied. The lowest lattice temperatures are 1 μK, which can be further reduced by adiabatic cooling to 650 nK, in agreement with a simple band structure model.
**University of Arizona. **National Institute of Standards and Technology.*

1. P. Verkerk et al., Phys. Rev. Lett. **68**, 3861 (1992).
2. P. S. Jessen et al., Phys. Rev. Lett. **69**, 49 (1992).
3. G. Grynberg et al., Phys. Rev. Lett. **70**, 2249 (1993).
4. A. Hemmerich and T. Hänsch, Phys. Rev. Lett. **70**, 410 (1993).

10:00—Coffee Break

SESSION M1 [ThU]: JOINT SYMPOSIUM ON SUBCRITICAL HIGH-INTENSITY LASER-PLASMA INTERACTIONS
Thursday morning, 6 October 1994
Loews Anatole Hotel
Senators Lecture Hall at 10:30
Howard M. Milchberg, presiding

10:30
M1 1 ThU1 (Invited) Development and applications of a plasma waveguide for intense laser pulses, Charles G. Durfee, James Lynch, Howard M. Milchberg, *Institute for Physical Science and Technology, University of Maryland at College Park, College Park, MD 20742. Internet: cdurfee@wam.umd.edu.* We have demonstrated a plasma waveguide,[1] which is generated through the shock expansion of a laser created and heated column of plasma into a background gas. Results are presented for the beam propagation characteristics of radiation guided by this plasma optical fiber. Applications to soft x-rays and nonliner optics are outlined.

1. C.G. Durfee III and H.M. Milchberg, Phys. Rev. Lett. 72,2409 (1993).

11:00
M1 2 ThU2 (Invited) Generation and measurement of femtosecond vacuum UV pulses, R. Sauerbrey, *Institut für Optik und Quantenelektronik, Friedrich-Schiller-Universität Jena, Max-Wien-Platz 1, D-07743 Jena, Germany. E-mail: OSR @ rz.uni-jena.de.* Tunable femtosecond vacuum UV pulses with up to 10 μJ in energy were generated by multiple-wave-mixing of short-pulse KrF and dye-laser radiation in rare gases. A new technique based on cross-phase modulation in a field-ionization-generated plasma to measure the duration of these ultrashort VUV/XUV pulses is reported.

11:30
M1 3 ThU3 Relativistic ponderomotive acceleration of electrons from a laser focus, C. I. Moore, J. P. Knauer, D. D. Meyerhofer, *Laboratory for Laser Energetics, University of Rochester, 250 East River Road, Rochester, NY 14623-1299. E-mail: ddm@lle.rochester.edu.* We present the first observations, to our knowledge, of the forward acceleration of electrons produced in the focus of a 1-ps, 1-μm, 10^{18} W/cm^2 laser. The electrons are field-ionized by the laser and ponderomotively accelerated out of the focus in less than 1 ps.
This work was supported by the U.S. Department of Energy Office of Basic Energy Sciences, Division of Chemical Sciences. Additional support was provided by the U.S. Department of Energy Office of Inertial Confinement Fusion under Cooperative Agreement No. DE-FC03-92SF19460, the University of Rochester, and the New York State Energy Research and Development Authority. The support of DOE does not constitute an endorsement by DOE of the views expressed in this article.

11:45
M1 4 ThU4 LISP: laser impulse space propulsion, Claude R. Phipps, *Chemistry and Laser Sciences Division, Los Alamos National Laboratory, Los Alamos, NM 87545.* Laser impulse space propulsion (LISP) is reviewed. Mission-dependent laser momentum coupling coefficient C_{mopt} is derived for minimum cost per unit mass delivered. Laser plasma interaction theory is used to relate C_{mopt} to pulsed laser parameters for common laser absorbers. LISP performance is estimated for space junk clearing and ground launch.

SESSION M2 [ThV]: JOINT SYMPOSIUM ON ULTRAFAST DIODE LASER SOURCES: 1
Thursday morning, 6 October 1994
Loews Anatole Hotel
Topaz Room at 10:30
Peter J. Delfyett, presiding

10:30
M2 1 ThV1 (Invited) High-power mode-locked semiconductor lasers, Alan Mar, John Bowers, *Department of Electrical and Computer Engineering, University of California, Santa Barbara, Sanata Barbara, CA 93106.* We compare and contrast different techniques for overcoming the problem of low output power from mode-locked semiconductor lasers. Tapered and arrayed lasers have been used successfully to increase the pulse saturation energy limit by increasing the gain cross section. Further improvements have been achieved by use of the MOPA configuration, which utilizes a tapered semiconductor amplifier stage to amplify pulses to energies in excess of 100 pJ and peak powers of nearly 30W.

11:00
M2 2 ThV2 (Invited) Semiconductor laser amplifier dynamics and femtosecond hybrid mode-locked lasers, A. Dienes, J. P. Heritage, M. Y. Hong, Y. H. Chang, P. J. Delfyett,* *Department of Electrical and Computer Engineering, University of California, Davis, CA 95616.* Pulses of 160-w peak power, as short as 200-fs, are produced after amplification and compression from a hybrid mode-locked system in which strong spectral and time-domain distortions are observed. We discuss our theory of subpicosecond pulse amplification which successfully models both spectral distortions and time-resolved dynamics. The improved theory includes not only the amplitude and phase effects of carrier heating but also spectral holeburning which does not contribute self-phase modulation. New experimental results on different amplifiers are presented.
**Center for Research and Education in Optics and Lasers (CREOL).*

11:30
M2 3 ThV3 Characteristics of pulses from passively mode-locked semiconductor lasers, Randal A. Salvatore, Thomas Schrans, Amnon Yariv, *Department of Applied Physics, 128-95, California Institute of Technology, Pasadena, CA 91125. Internet: randysal@cco.caltech.edu.* For the first time, pulse shape and the quadratic as well as a linear chirp are measured from a passively mode-locked semiconductor laser. Pulses exiting the laser are found to be asymmetric with fall times 2.0 to 2.5 times longer than rise times. Quadratic chirp of -60 fs/nm/nm is directly measured along with about -800 fs/nm linear chirp.

11:45
M2 4 ThV4 Ultrafast gain dynamics in InGaAlP lasers, J. A. Tatum, M. Hofmann,* J. Sacher,* D. L. MacFarlane, *University of Texas at Dallas, Richardson, TX 75083. E-mail: dlm@utdallas.edu.* We study the gain dynamics in visible wavelength diode laser amplifiers using pump and probe techniques. The gain recovery time, which is typically less than 1 ps, is studied as a function of bias current and probing wavelength. The spectral transmittance of the probe pulse is also investigated.
**Phillips University, Germany.*

SESSION M3 [ThW]: JOINT SYMPOSIUM ON NOVEL LASER TECHNIQUES FOR CLUSTER SPECTROSCOPY: 1
Thursday morning, 6 October 1994
Loews Anatole Hotel
Sapphire Room at 10:30
John Cameron Miller, presiding

10:30
M3 1 ThW1 (Invited) Spectroscopy of metal ion complexes, Michael A. Duncan, *Department of Chemistry, University of Georgia, Athens, GA 30602. Internet: maduncan@ uga.cc.uga.edu.* Metal cluster complexes containing a variety of neutral or ionized metal atoms bound electrostatically to small molecules or rare gas atoms are produced in a pulsed nozzle source (e.g., Mg^+-CO_2, Mg^+-H_2O, Al^+-Ar). These complexes are studied with mass-selected photodissociation spectroscopy and mass-analyzed threshold ionization spectroscopy (MATI). Vibrationally-resolved spectra are obtained, and in some cases there is partial rotational resolution. Metal-ligand vibrational progressions dominate the electronic spectra of these species. The spectra make it possible to obtain vibrational frequencies, dissociation energies, and structures for these novel metal complexes.

11:00
M3 2 ThW2 Potential energy of M(np^{2}P).RG(^{2}) excited state and M$^+$.RG ground states (M=Li,Na; RG=He,Ne), Solomon Bililign, Maciej Gutowski,* Jack Simons,** W. H. Breckenridge,** *Department of Physics, North Carolina A&T State University, Greensboro, NC 27411. Internet: BILILIGN@NCAT.EDU.* The bond energies for the valence pπ excited state of Group 1 (^{2}P) and Group 2 (^{1,3}P) metal-atom/rare-gas (M.RG) complexes tend to increase with the polarizabilities of the RG atom. The corresponding M$^+$.RG ground-state ions have greater binding energies than those of the neutral M(pδ).RG excited states with the same RG atom. Two *stark exceptions* were observed in the trend. *Ab initio* calculations of the potential energy curves of M(np^{2}P).RG($^2\Pi$) and M$^+$.RG states (M=Li,Na and RG=He,Ne) are performed and results compared with spectroscopic results. The results of the calculations and our analysis is presented.
**IBM Research Division. **University of Utah.*

11:15
M3 3 ThW3 Double-resonance studies of CH-Ne and CN-Ne Van der Waals complexes, William H. Basinger, William E. Lawrence, Udo Schnupf, Michael C. Heaven, *Department of Chemistry, Emory University, Atlanta, GA 30322. E-mail: CHEMMH@EMRXCC.* The triatomic open-shell complexes CH-Ne and CN-Ne have been observed by electronic spectroscopy.[1-2] Transitions involving orbitally degenerate states of the diatom (CH[$A^2\Delta$-$X^2\Pi$]-Ne and CN[$A^2\Pi$ -$X^2\Sigma$]-Ne) exhibited complicated fine structure. Fluorescence depletion techniques are being used to facilitate the analyses of these spectra. Molecular constants and potential energy surfaces, derived from *ab-initio* and spectroscopic data, are presented.

1. W. H. Basinger, U. Schnupf, and M. C. Heaven, *Faraday Discuss.* **97**, 20 (1994).
2. S. Fei and M. C. Heaven, *J. Chem. Phys.* **98**, 753 (1993).

11:30
M3 4 ThW4 Using broadly-tunable OPO technology to capture the CH_3I^- electron-molecule scattering complex at the "half-collision", David Serxner, Christopher Bailey, Donna Cyr, Georgina Scarton, Mark A. Johnson, *Sterling Chemistry Laboratory, Yale University, New Haven CT 06511.* The excess electron in the CH_3I^- transient anion is interesting in that it evolves from a continuum to a bound state with increasing C-I bond distance, leading to a strong dependence of the electronic wavefunction on intramolecular geometry. The critical region is explored by exciting intra-cluster electron scattering transitions between I^- and CH_3I in the $I^- \cdot CH_3I$ ion-molecule complex.

SESSION M4 [ThX]: JOINT SYMPOSIUM ON MANIPULATION OF ATOMS WITH LIGHT: NANOKELVIN COOLING: 2
Thursday morning, 6 October 1994
Loews Anatole Hotel
Wedgwood Room at 10:30
Roger W. Phillips, presiding

10:30
M4 1 ThX1 (Invited) Laser cooling by coherent population trapping in 1, 2, and 3 dimensions, J. Lawall, F. Bardou, B. Saubamea, K. Shimizu, M. Leduc, A. Aspect, C. Cohen-Tannoudji, *Collège de France et Laboratoire Kastler Brossel de l'Ecole Normale Supérieure, 24 rue Lhomond, 75231 Paris Cedex 05, France.* Starting from a cloud of precooled and trapped metastable helium atoms, we have been able to improve the efficiency of laser subrecoil cooling methods using velocity selective coherent population trapping. Extensions of these methods to dimensions higher than one are described.

11:00
M4 2 ThX2 Transient heating and cooling in travelling-wave velocity-selective coherent population trapping, M. S. Shahriar, M. G. Prentiss,* P. R. Hemmer,** *Research Laboratory of Electronics, Massachusetts Institute of Technology, Room 26-368, Cambridge, MA 02139. Internet: smshahri@athena.mit.edu.* We show that, contrary to established belief, semi-classical friction force exists in travelling-wave velocity-selective coherent population trapping. For red (blue) detuning, cooling (heating) occurs via a transient process. This may help explain the difference found, in quantum simulations, in the momentum distributions for different signs of detunings.
**Harvard University. **Rome Laboratory, Hanscom Air Force Base.*

THURSDAY AFTERNOON

SESSION PL45 [ThDD]: ILS PLENARY: 5
Thursday afternoon, 6 October 1994
Loews Anatole Hotel
Wedgewood Room at 13:00
Philip H. Bucksbaum, presiding

13:00
PL45 1 ThDD1 (Plenary) **Precision spectroscopy of hydrogen,** T. W. Hänsch, *Max-Planck-Institut für Quantenoptik, 85748 Garching, Germany.* Precision spectroscopy of hydrogen is still advancing rapidly. Two-photon spectroscopy of the 1S-2S transition has reached a resolution of $3 \cdot 10^{-12}$. A new phase-coherent frequency measurement is reported. The 1S Lamb shift reveals unexpectally large 2-loop corrections. The H-D isotope shift begins to reveal effects of internal nuclear dynamics.

SESSION N1 [ThKK]: JOINT SYMPOSIUM ON SOLID-DENSITY LASER-MATTER PHYSICS: 1
Thursday afternoon, 6 October 1994
Loews Anatole Hotel
Senators Lecture Hall at 13:30
Jean-Claude Kieffer, presiding

13:30
N1 1 ThKK1 (Invited) **Dynamics of subpicosecond laser plasmas using two collinear high-intensity pulses,** C. Y. Côté, J. C. Kieffer, M. Chaker, O. Peyrusse,* *INRS-Énergie et Matériaux, 1650 Montée Ste-Julie, Varennes, Canada J3X 1S2. E-mail: cote@inrs-ener.uquebec.ca.* By using the INRS-T^3 system, the interaction of a 500-fs green laser pulse-focused at 10^{17} W/cm^2 with an adjustable gradient-scalelength plasma produced by a short prepulse is studied. Picosecond time-resolved keV spectroscopy is used to characterize the plasma parameters as a function of the delay between the two pulses.
**CEA-Limeil, Villeneuve St-Georges, France.*

14:00
N1 2 ThKK2 **Giant local-field fluctuations and production of plasmas at rough surfaces by femtosecond pulses,** Mark I. Stockman, Lakshmi N. Pandey, Leonid S. Muratov, Thomas F. George, *Departments of Physics and Chemistry, Washington State University, Pullman, WA 99164. E-mail: stockman@Jaguar.csc.wsu.Edu.* Giant fluctuations of local optical fields at rough surfaces modeled as fractals are theoretically predicted. The corresponding distribution function is found and shown to scale. Applications to various laser-induced phenomena, including nonlinear photochemistry, desorption, and hot plasma formation, are discussed. During a fs laser pulse, the plasma preserves the geometry of the former solid and is strongly inhomogeneous. The giant fluctuations bring about formation of "hot spots" responsible for x-ray emission.

14:15
N1 3 ThKK3 **High-order harmonic generation at metal surfaces,** T. Tsang, T. Srinivasan-Rao, J. Fischer, *Brookhaven National Laboratory, Upton, NY 11973. Internet: Tsang@BNLCL1.BNL.GOV.* Optical harmonics up to the fifth order were generated in reflection from metal mirrors with the highest photon yield at the third-harmonic. A laser-pulse-induced self-phase-modulation, which occurred on all harmonics, was observed resulting in a broadened and red-shifted spectrum.

SESSION O'2 [ThQQ]: JOINT SYMPOSIUM ON ULTRAFAST DIODE LASER SOURCE: 2
Thursday afternoon, 6 October 1994
Loews Anatole Hotel
Topaz Room at 14:00
A. Dienes, presiding

14:00
O'2 1 ThQQ1 (Invited) **Ultrafast nonlinear refractive index dynamics in active semiconductor waveguides,** C. T. Hultgren, E. P. Ippen, *Department of Electrical Engineering and Computer Science and Research Laboratory of Electronics, Massachusetts Institute of Technology, 77 Massachusetts Avenue, Room 36-325, Cambridge, MA 02139. E-mail: charlie7@athena.mit.edu.* Pump-probe studies of above- and below-band refractive index nonlinearities in active AlGaAs waveguides are performed using 100-femtosecond optical pulses. We observe an ultrafast refractive index dynamic caused by carrier heating, as well as an instantaneous index transient caused by the optical Stark effect. These dynamics are studied over a range of wavelengths and carrier densities.

14:30
O'2 3 ThQQ3 **Frequency chirp reduction in two-section distributed feedback lasers by nonuniform current injection,** J. Feng, T. R. Chen, B. Zhao, A. Yariv, *California Institute of Technology, MS 128-95, Pasadena, CA 91125-0001. E-mail: jfeng@cco.caltech.edu.* The effect of nonuniform current injection on the frequency chirp in semiconductor distributed feedback (DFB) lasers has been investigated. By using two-section InGaAsP/InP DFB lasers, we have found that the frequency chirp, accompanying the high-frequency-intensity modulation to the lasers, can be reduced by adjusting the injection current distribution in the lasers. A theoretical analysis is also presented to explain the experimental results.

14:45
O'2 2 ThQQ2 **Femtosecond pulse dynamics in semiconductor amplifiers,** R. A. Indik, A. Knorr,* R. Binder,** J. V. Moloney, W. W. Chow,*** and S.W. Koch,**** *Department of Mathematics, University of Arizona, Tucson, AZ 85721. E-mail: jml@math.arizona.edu.* Simulation of pulse propagation in semiconductor amplifiers using the microscopic many-body theory predicts propagation-induced adiabatic following leading-to-pulse compression and nondegenerate four-wave mixing interaction, the details of which depend on the relative disposition of the nominal carrier frequency with respect to the linear gain maximum.
**Philipps Universitat Marburg, Germany. **Optical Sciences Department. ***Sandia National Laboratory. ****Philipps Universitat Marburg, Germany.*

15:00
O'2 4 ThQQ4 **All-optical, high-speed InGaAs/GaAs MQW reflection modulator for a high-intensity probe beam at 1.064 μm,** J. D. Berger, D. Boggavarapu, H. M. Gibbs, G. Khitrova, *Optical Sciences Center, University of Arizona, Tucson, AZ 85721. E-mail: jberger@ccit.arizona.edu.* A novel nonlinear NOR-gate InGaAs/GaAs MQW reflection modulator with a combined distributed-feedback/Fabry-Pérot structure capable of modulating a high-intensity probe beam (~ 50 mW) at rates exceeding 1 GHz is demonstrated. This device is uniquely suited for high-speed analog modulation of a diode laser probe with equal or greater power than the pump.

SESSION O'3 [ThRR]: JOINT SYMPOSIUM ON NOVEL LASER TECHNIQUES FOR CLUSTER SPECTROSCOPY: 2
Thursday afternoon, 6 October 1994
Loews Anatole Hotel
Sapphire Room at 14:00
John C. Miller, presiding

14:00
O'3 1 ThRR1 **(Invited) Fullerene ions,** Robert N. Compton, *Oak Ridge National Laboratory, P.O. Box 2008, Oak Ridge, TN 37831-6125. Ethernet: AHD@STC10.CTD.ORNL.GOV.* Some unusual properties of the fullerene molecules C_{60}/C_{70} and their derivatives (La @ C_{60}, Ar @ C_{60}, $C_{60}H_{36}$, $C_{60}F_{48}$) are presented. Thermionic photoemission of C_{60}/C_{70} is observed using an Ar-ion laser ($<10^5$W/cm^2). The profound effect of angular momentum and Coulomb barriers to the addition or removal of one or two electrons to C_{60}/C_{70} is introduced.

14:30
O'3 2 ThRR2 **Second-harmonic generation of supported metal clusters,** M. Buck,* Chr. Dressler,* T. Götz, W. Hoheisel, F. Träger, *Fachbereich Physik, Universität Kassel, Heinrich-Plett-Straße 40, 34132 Kassel, Germany. E-mail: hoheisel@physik.uni-kassel.de.* Optical SHG of supported metal particles has been studied under UHV-conditions. The particles were kept at a constant number density and were well characterized regarding their size and shape. The SHG-signal has been recorded for a wide-range of particle sizes and shapes as well as for different excitation wavelengths and angles of incidence.
**Universität Heidelberg, Heidelberg, Germany.*

14:45
O'3 3 ThRR3 **Characteristics of matrix-assisted UV laser desorption/ionization mass spectroscopy of large biomolecules,** Indral K. Perera, Peter E. Dyer, Stamatina Kantartzoglou, *Department of Applied Physics, University of Hull, Hull, HU6 7RX, England.* The time-of-flight mass spectrometric analysis of large biomolecules (<150,000 u), using new matrices for ion desorption is reported. The formation of cluster ions and the influence of some experimental parameters on the ion-yield intensity and the mass resolutions are discussed.

SESSION O'4 [ThSS]: JOINT SYMPOSIUM ON MANIPULATION OF ATOMS BY LIGHT: ATOM OPTICS AND INTERFEROMETRY: 1
Thursday afternoon, 6 October 1994
Loews Anatole Hotel
Wedgwood Room at 14:00
Wayne M. Itano, presiding

14:00
O'4 1 ThSS1 **(Invited) Precision measurements with atom interferometry,** Brenton C. Young, Martin Weitz, Steven Chu, *Department of Physics, Stanford University, Stanford, CA 94305-4060. I: bcyoung@leland.stanford.edu.* Results of adiabatic population transfer are presented. We have observed transfer efficiencies of >95% in the Doppler-sensitive mode, and >98.6% in the Doppler-free mode. A working atom interferometer based on adiabatic beam splitters is also reported, and the systematic limitations to atom interferometry measurements are discussed.

14:30
O'4 2 ThSS2 **Study of momentum transfer with laser-cooled atoms,** J. C. Robinson, C. Bharucha, F. L. Moore, M. G. Raizen, *Department of Physics, The University of Texas at Austin, Austin, TX 78712. E-mail: Raizen@utaphy.ph.utexas.edu.* An experimental study of momentum transfer from a time-varying standing wave of light to a sample of ultra-cold sodium atoms is reported. This system is used to study quantum chaos in a modulated standing wave, and to develop newtechniques of momentum transfer for applications in atom optics and atomic interferometry.

14:45
O'4 3 ThSS3 **Laser cooling of aluminum atoms at 309 nm,** Roger McGowan, Siu Au Lee, *Department of Physics, Colorado State University, Fort Collins, CO 80523. Internet: rmcgowan@lamar.colostate.edu.* Single-frequency laser cooling of an aluminum atomic beam in a 1D optical molasses was demonstrated. Laser light at 309 nm was used to excite the closed UV transition from the metastable $3p^2P_{3/2}$ to $3d^2D_{5/2}$. This collimated beam will be used to write a grating of aluminum with spacing of 154.5 nm.

3:00—Coffee Break

SESSION P1 [ThXX]: JOINT SYMPOSIUM ON SOLID-DENSITY LASER-MATTER PHYSICS: 2
Thursday afternoon, 6 October 1994
Loews Anatole Hotel
Senators Lecture Hall at 15:30
Jean-Claude Kieffer, presiding

15:30
P1 1 ThXX1 **(Invited) New aspects in the modeling of ultrashort plasmas spectroscopy,** O. Peyrusse, *CEA-Limeil, 94195 Villeneuve-St-Georges, Cedex, France. E-mail: peyrusse@limeil.cea.fr.* Ultrashort laser-produced plasma physics offers a unique opportunity to study dense plasmas in the laboratory. However, the very small size and very short life of the plasmas involved go beyond some of the standard hypothesis of plasma spectroscopy modeling. Among the new aspects discussed are non-steady-state atomic physics, nonmaxwellian free electron distributions, and the necessity of computing a full time-dependent plasma x-ray emission (including Stark line-broadening) for the purpose of interpreting the data.

16:00
P1 2 ThXX2 **(Invited) Ultrashort pulse laser-solid interactions at the Lawrence Livermore National Laboratory ultrashort pulse laser,** Ronnie Shepherd, Dwight Price, Gary Guethlein, Bruce Young, Jim Dunn, Richard More, Rosemary Walling, Albert Osterheld, Bill White, William Goldstein, Richard Stewart, *Lawrence Livermore National Laboratory, P.O. Box 808, L-43, Livermore, CA 94551.* Ultrashort pulse lasers have provided a feasible means of creating high energy-density matter. The experiments we are currently conducting focus on heating solid-density matter to high (>100 eV) temperatures. The laser used in the experiments produce 140-fs, 60-mJ, 800-nm pulses which are frequency-doubled and focussed to 3-μm diameter to yield high-contrast ($<10^{-6}$ prepulse), high peak intensity ($>10^{18}$ W/cm^2), laser-solid interactions. Numerous diagnostics are used to study the interaction. The measurements include the absorbed energy, time-integrated x-ray spectroscopy, particle energy measurements, and a new 900-fs x-ray streak camera is used to study the time-resolved broadband x-ray emission. The measurements are compared with calculations. The data and analysis from these experiments are presented.
Work performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under contract number W-7405-ENG-48.

16:30
P1 3 ThXX3 Asymmetries in plasma-broadened x-ray lineshapes, R. C. Mancini, D. P. Kilcrease,* J. Abdallah, Jr.,**Department of Physics, University of Nevada, Reno, NV 89557. E-mail: rcman@unrlaser.physics.unr.edu.* X-ray emission from solid-density plasmas generated during the interaction of ultrashort, high-intensity laser pulses with solid targets can show significant Stark-broadening due to the plasma electric microfields. Furthermore, higher-order effects which usually result in line-asymmetries can also be important. Several types of asymmetries and their dependence with temperature and density are discussed, and results obtained with theoretical models are presented.
**Los Alamos National Laboratory.*

16:45
P1 4 ThXX4 Electron kinetic simulations of high-intensity, ultrashort pulse laser-matter interaction, S. Ethier, J. P. Matte, J. C. Kieffer, M. Chaker, O. Peyrusse,**INRS-Énergie et Matériaux, 1650 Montée Ste-Julie, Varennes, Canada J3X 1S2. E-mail: ethier@inrs-ener. uquebec.ca.* Electron kinetic simulations of high-intensity ($\geq 10^{17}$ W/cm^2) ultrashort pulse (300-fs) laser target interaction, assuming high contrast are presented. Ponderomotive force effects play a key role in the interaction. Post-processing of the distribution functions with the detailed atomic physics code "TRANSPEC" allows us to compare with experiments.
**CEA-Limeil, France.*

SESSION P2 [ThYY]: JOINT SYMPOSIUM ON APPLICATIONS OF LASER MATERIALS PROCESSING
Thursday afternoon, 6 October 1994
Loews Anatole Hotel
Topaz Room at 15:30
Andrew C. Tam, presiding

15:30
P2 1 ThYY1 (Invited) Permanently electrically-conducting polymers generated by ultraviolet laser pulses, R. Sauerbrey,*Institute für Optik und Quantenelektronik, Friedrich-Schiller-Universität Jena, Max-Wein-Platz 1, D-07743 Jena, Germany. E-mail: OSR @ rz.uni-jena.de.* The electrical conductivity of high-temperature polymers has been changed permanently from 10^{-17} ohm^{-1} to 10 ohm^{-1} by KrF (248 nm) excimer laser irridation. The conduction mechanism is found to be phonon-assisted variable range-hopping between small (~ 10 nm) carbon-rich clusters that form a macroscopic percolation cluster. Using a holographic technique submicron-conducting periodic line structures have been produced in polimide with a KrF excimer laser.

16:00
P2 2 ThYY2 (Invited) Pulsed-laser ablation, D. Bäuerle, *Angewandte Physik, Johannes-Kepler-Universität, Altenberger Strre. 69, Linz, Austria A4040. E-mail: dieter.baeuerle@jk.uni-linz.ac.at, B.* Pulsed lasers are a powerful tool for surface modifications, surface patterning by ablation, and thin-film formation by pulsed-laser deposition (PLD). Recent results, including the role of surface instabilities and structure formation in these processes, are discussed.

16:30
P2 3 ThYY3 Noncontact investigation of surface-coating adhesion by laser-induced acoustic waves, Markus W. Sigrist, Peter Weiss, *Swiss Federal Institute of Technology (ETH), Institute of Quantum Electronics, CH-8093 Zurich, Switzerland. I: sigrist@iqe.phys. ethz.ch.* Adhesion properties of surface coatings are studied by a noncontact laser spallation technique. Shock waves are generated in the sample by Nd:Y:AG laser impact on the backside while the induced transient surface displacements on the front (coating) face are detected time-resolved with a homodyne fiberoptic interferometer.[1] Recent quantitative results on the adhesion and debonding of nickel- and plasma-sprayed ceramic coatings are discussed.
1. P. Weiss and M. W. Sigrist, Ultrasonics Int. '93, 531-534.

16:45
P2 4 ThYY4 Optical probing of the temperature and pressure transients at a liquid-solid interface due to pulsed laser-induced vaporization, Hee K. Park, Costas P. Grigoropoulos, Oguz Yavas,* Chie C. Poon,** and Andrew C. Tam,***Department of Mechanical Engineering, University of California, Berkeley, CA 94720. I: hkpark@euler. berkeley.edu.* Temperature transients developed in the excimer laser-induced explosive vaporization of liquids on a solid surface is studied. The in-situ optical reflectance observed from an embedded temperature-sensitive film determines the temperature evolution with nanosecond resolution. This optical probe is used to study the termodynamics of vaporization in a high-pressure cell. (Yavas, et al., Phys. Rev. Lett. **70**, 1830 (1993).
**University of Konstanz, Germany. **IBM Almaden Research Center.*

17:00
P2 5 ThYY5 Laser-induced photobleaching in Γ-irradiated doped Ωuorite: fabrication of absorbing layers with variable transmission in visible and near-IR regions, S. G Lukishova, E. A. Magulariya,* *Institute of Radioengineering and Electronics of the Russian Academy of Sciences, 11 Mokhovaya, 103907, Moscow, Russia. E-mail: lab221 ire.uucp.free.msk.su.* The photo-oxidation of Pr ions in divalent state in CaF2 lattice under the irradiation of 248-530 nm lasers is investigated for the purpose of creating soft apertures with radially-variable transmission for near-IR lasers. The kinetics of photobleaching of Γ-colored Ωuorite is considered. The fabricated soft apertures with bell-like transmission profiles are used in 1.06 and 2.94 micron lasers for improvement of beam quality.
**Moscow Institute of Physics and Technology.*

SESSION P3 [ThZZ]: JOINT SYMPOSIUM ON NOVEL LASER TECHNIQUES FOR CLUSTER SPECTROSCOPY: 3
Thursday afternoon, 6 October 1994
Loews Anatole Hotel
Sapphire Room at 15:30
John C. Miller, presiding

15:30
P3 1 ThZZ1 (Invited) Cavity ringdown laser absorption spectroscopy: a new analytical technique for cluster science, Jim J. Scherer, Josh B. Paul, Anthony O'Keefe,* Richard J. Saykally, *Department of Chemistry, University of California, Berkeley, CA 94720-1460. Bitnet: rjs@hydrogen.cchem.berkeley.edu.* The cavity ringdown method for measuring very weak absorptions with pulsed lasers has been combined with laser vaporization/supersonic beam generation of refractory clusters. Design and performance specifications are presented, along with results for particular systems.
**Los Gatos Research.*

16:00
P3 2 ThZZ2 Cavity ringdown absorption spectroscopy of halogen systems, Richard A. Loomis, Rebecca L. Schwartz, Marsha I. Lester, *Department of Chemistry, University of Pennsylvania, Philadelphia, PA 19104-6323. I: lester@a.chem.upenn.edu.* The high sensitivity and applicability of the cavity ringdown technique are illustrated in electronic absorption spectra of halogen molecules and complexes in a molecular beam. Spectra exhibit noise levels of ≤ 1 ppm and signal/noise > 600. Of particular interest is the observation of the short-lived, predissociative IC1 $B^3\Pi_{0+}$ v=3 state.

16:15
P3 3 ThZZ3 (Invited) Time-resolved photochemistry in ionic clusters, W. Carl Lineberger, *Department of Chemistry and Biochemistry, University of Colorado and Joint Institute for Laboratory Astrophysics, Boulder, CO 80309-0440.* Ultrafast pump-probe studies of

photodissociation and the subsequent recombination or photochemistry in size-selected ionic clusters ($ICl^-(CO_2)_n$, $I_2^-(CO_2)_n$, $(O_2)_n^-$) is discussed. The experiments provide direct measurements of the effect of partial solvation on the electronic structure of the solute.

16:45
P3 4 ThZZ4 (Invited) Cluster anion formation by state-selected Rydberg electron transfer, Howard S. Carman, Jr., *Chemical Physics Section, Oak Ridge National Laboratory, Oak Ridge, TN 37831-6125. Internet: carmanhsjr@ornl.gov.* Electron transfer from laser-excited, state-selected Rydberg atoms to atomic and molecular clusters provides a unique and powerful method for producing and studying cluster anions. Recent experiments are described in which the method has been used to study low-energy (~2-150 meV) electron attachment processes in several cluster systems.

17:15
P3 5 ThZZ5 Laser-induced polymerization within clusters, S. Desai, C. S. Feigerle, J. C. Miller, *Oak Ridge National Laboratory, P.O. Box 2008, Oak Ridge, TN 37831-6125. Ethernet: MILLERJC@ORNL.GOV.* A molecular beam analogue of "laser snow" is reported where photochemical polymerization occurs within molecular clusters. Mass spectrometry indicates the presence of S_m^+, $S_m^+(CS_2)_n$, $(CS)^+_m$, and $(CS_2)^+_n$ polymers following two-photon ionization of CS_2 clusters. A cycle of photoinduced ion-molecule reactions is proposed to explain the observed ions.

SESSION P4 [ThAAA]: JOINT SYMPOSIUM ON MANIPULATION OF ATOMS BY LIGHT: ATOM OPTICS AND INTERFEROMETRY: 2
Thursday afternoon, 6 October 1994
Loews Anatole Hotel
Wedgwood Room at 15:30
Wayne M. Itano, presiding

15:30
P4 1 ThAAA1 (Invited) Interferometry with atoms and molecules, Michael S. Chapman, Christopher R. Ekstrom, Jörg Schmiedmayer, Troy D. Hammond, Stefan Wehinger, David E. Pritchard, *Massachusetts Institute of Technology, 77 Massachusetts Avenue, Room 26-240, Cambridge, MA 02139.* By inserting a gas cell in one arm of a separated beam interferometer, we measured the attenuation and phase-shift of Na and Na_2 matter waves passing through various gases, determining the complex index of refraction for these waves. This yields previously inaccessible information about atomic scattering.

16:00
P4 2 ThAAA2 A dark-state atom interferometer, Lori S. Goldner, S. L. Rolston, W. D. Phillips, *National Institute of Standards and Technology, Gaithersburg, MD 20899. E-mail: lori@nist.gov.* Calculations regarding a new type of atom interferometer where atoms in a "dark" (non-fluorescing) state are split and recombined with light are presented. To form the interferometer, atoms adiabatically follow a changing light field, resulting in a redistribution of photon and atomic moments.

16:15
P4 3 ThAAA3 Traveling-wave-induced nonadiabatic transitions in blazed grating atomic beamsplitter, K. S. Johnson, A. P. Chu, M. S. Shariar,* K. Berggren, M. G. Prentiss, *Department of Physics, Harvard University, Cambridge, MA 02138. E-mail: Kent@Atomsun.Harvard.Edu.* A novel asymmetry in the magnetic-field free-blazed grating atomic beam splitter using the V system was observed. The asymmetry appears as an overall deflection of the split beams in the direction opposite to that of the residual traveling waves. Experimental results in qualitative agreement with theory are presented.
**Massachusetts Institute of Technology.*

16:30
P4 4 ThAAA4 Measurement-induced localization of atoms in an optical cavity: a quantum-trajectory-approach, A. M. Herkommer, H. J. Carmichael,* W. P. Schleich,** *Abteilung für Quantenphysik, Universität Ulm, D-89069 Ulm, Germany.* We use the method of stochastic wavefunctions,[1] which links measurement theory with quantum-jump simulations[2] to describe a continuous homodyne measurement[3] on a single-mode of an electro-magnetical light-field. We show that the measurement leads to a spatial localization[4] of a resonantly coupled two-level atom.

1. H. J. Carmichael, *An Open Systems Approach to Quantum Optics,* (Springer, Berlin, 1993).
2. K. Mølmer, Y. Castin, and J. Dalibard, J. Opt. Soc. Am. B **10**, 524 (1993).
3. H. M. Wiseman and G. J. Milburn, Phys. Rev. A **47**, 642 (1993).
4. P. Storey, M. Collett, and D. Walls, Phys. Rev. Lett. **68**, 472 (1992))

16:45
P4 5 ThAAA5 Velocity selection in Bragg scattering of atoms, David M. Giltner, Siu Au Lee, *Department of Physics, Colorado State University, Fort Collins, CO 80523. Internet: dgiltner@lamar.colostate.edu.* We have studied Bragg scattering of neon from a standing light wave for the purpose of constructing an atom interferometer. The standing wave acts like a grating which selects the proper de Broglie wavelength, or longitudinal velocity, of the atoms. A narrowed velocity profile for the scattered atoms has been observed.

17:00
P4 6 ThAAA6 New results on a cesium atomic fountain, Ph. Laurent, S. Ghezali, G. Santarelli, S. Lea, M. Bahoura, A. Clairon, *Laboratoire Primaire du Temps et des Fréquences (LPTF), BNM, Observatoire de Paris, 61 av. de l'Observatoire, 75014 Paris, France.* A fountain of ultracold cesium atoms as frequency standard offers at least an improvement of a factor 10 in both stability and accuracy over cesium beam frequency standards. The LPTF fountain have operated since January 1994. We typically obtain a 1-Hz Ramsey fringe with a signal-to-noise ratio of several hundreds per cycle. An evaluation of this clock is presently under way.

17:15
P4 7 ThAAA7 Analog of paramagnetic phase transitions in atom traps, Jonathan P. Dowling, Charles M. Bowden, *U.S. Army Missile Command, AMSMI-RD-WS-ST, Redstone Arsenal, AL 35898-5428. Internet: jpd2@aip.org.* As a complement to recent work on Bose condensation of atoms in traps, the atom optic analog of the type of paramagnetic phase transitions that are usually associated with spin gases is discussed. This effect is distinct from Bose condensation and perhaps easier to observe experimentally.

SESSION Q6 [FD]: JOINT SYMPOSIUM ON MANIPULATION OF ATOMS BY LIGHT: COLD COLLISIONS 1
Friday morning, 7 October 1994
Loews Anatole Hotel
Governors Lecture Hall at 8:30
John Weiner, presiding

8:30
Q6 1 FD1 (Invited) Combining atoms into molecules with laser light, D. J. Heinzen, R. A. Cline, J. D. Miller, *Department of Physics, University of Texas, Austin, TX 78712. E-mail: Heinzen@utaphy.ph.utexas.edu.* The results of cold atom photoassociation experiments are presented, and it is shown how these results can be used to determine long-range interatomic interaction parameters such as scattering lengths. Use of a far-off resonance dipole trap (FORT) and efforts to trap atoms in a "dark" FORT are also discussed.

9:00
Q6 2 FD2 (Invited) **Two-color photoassociative ionization: dynamics in ultracold collisions**, V. Bagnato, L. Marcassa, S. Zílio, Y. Wang,* J. Weiner,* *University of São Paulo, IFQSC - DFCM, S. Carlos, SP - Cx., Postal 369, 13560-970, Brazil.* Experimental results and interpretation for two-color spectroscopy of colliding ultracold atoms are presented. The individual steps of photoassociative ionization are observed. The spectrum of long-range vibrational states is reported.
**University of Maryland.*

9:30
Q6 3 FD3 (Invited) **Collisions of magneto-optically-trapped lithium atoms**, Randall G. Hulet, N. W. M. Ritchie, E. R. I. Abraham, W. I. McAlexander, *Department of Physics and Rice Quantum Institute, Rice University, Houston, TX 77251. Internet: randy@atomcool.rice.edu.* Measurements of the rate of collisional loss from a MOT for both ^{6}Li and ^{7}Li are presented. Accurate comparisons with theory require knowledge of the escape velocity from the MOT, which is calculated using a new model. Photoassociative spectra for the high-lying vibrational levels of the $1^1\Sigma_u^+$ and the $1^3\Sigma_g^+$ states of Li_2 are also presented from which a precise value for the atomic radiative lifetime is derived.

SESSION Q1 [FE]: JOINT SYMPOSIUM ON HIGH-FIELD LASER-MATTER PHYSICS: ATOMS AND MOLECULES 1

Friday morning, 7 October 1994
Loews Anatole Hotel
Senators Lecture Hall at 8:30
Kenneth Schafer, presiding

8:30
Q1 1 FE1 (Invited) **A time-dependent view of strong-field multiphoton physics**, Kenneth C. Kulander, *Theoretical Atomic and Molecular Physics Group, Lawrence Livermore National Laboratory, Livermore, CA 94551. E-mail: kulander@llnl.gov.* Very high-order processes in strong laser fields can be understood by analyzing the dynamics of time-evolving wave functions. Electron and photon emission spectra from atoms and the competition between ionization and dissociation in molecules are interpreted in terms of the behavior of laser-excited wavepackets.
This work has been carried out under the auspices of the US Department of Energy at Lawrence Livermore National Laboratory under contract number W-7405-ENG-48.

9:00
Q1 2 FE2 (Invited) **Imaging photoelectrons from strong field ionization**, Hanspeter Helm, *SRI International.* Abstract not available at press time.

9:30
Q1 3 FE3 (Invited) **High sensitivity studies of above-threshold ionization**, B. Sheehy, *Department of Chemistry, Brookhaven National Laboratory, Upton, NY 11973. Bitnet: sheehy@BNLC.* Theoretical models offering a unified description of various strong-field phenomena are critically tested in two ATI experiments. Semiclassical scattering models and quantum mechanical SAE calculations are compared with measured structures in the angular distributions of photoelectrons in long-pulse (50 psec) experiments with rare gases. Enhanced double ionization observed in a short pulse (160 fsec) experiment with helium, is found to scale with the ac tunneling component of the single ionization yield, and shows inconsistencies with scattering models.
Funded by the Department of Energy.

SESSION Q3 [FF]: JOINT SYMPOSIUM ON HIGH RESOLUTION TIME-DOMAIN SPECTROSCOPY

Friday morning, 7 October 1994
Loews Anatole Hotel
Sapphire Room at 8:30
Peter Felker, presiding

8:30
Q3 1 FF1 (Invited) **Structural measurements of isolated polar clusters**, Michael R. Topp, John R. Stratton, Brian A. Pryor, Philip G. Smith, Thomas Troxler, *Department of Chemistry, University of Pennsylvania, Philadelphia, PA 19104-6323. Internet: topp@a.chem.upenn.edu.* Picosecond time-correlated single-photon counting spectroscopy (TCSPC) and picosecond time-resolved stimulated-emission pumping (TRSEP) spectroscopy, have been used to investigate the dynamics and structural properties of molecular aggregates involving the perylene molecule. Clusters involving up to three cyclopropane molecules have confirmed that the structures of the aggregates are determined by corrugations in the aromatic surface, so that the symmetries are lowered. Clusters involving alkyl halide molecules exhibit multiple isomers; many of which have now been structurally identified via rotational coherence spectroscopy. Moreover, the relationship between vibrational energy redistribution and photoisomerization dynamics has been explored via TRSEP spectroscopy. Multipolar interactions have further been investigated through structural studies of naphthalene and benzene complexes of perylene, which exhibit dramatically different dynamical properties.

9:00
Q3 2 FF2 (Invited) **Controlling molecular energy levels with shaped pulses**, W.S. Warren, *Department of Chemistry and the Princeton Center for Photonics and Opto-Electronic Materials, Princeton University, Princeton, New Jersey 08544-1009. E-mail: WWARREN@PUCC.Princeton.edu.* Several new techniques recently developed in our laboratory dramatically improve capabilities for generating complex optical waveforms, including phase and amplitude modulation. The uses of such highly-shaped pulses, particularly in the strong-response limit where the amplitude of the optical field significantly changes the internal molecular dynamics are discussed.

9:30
Q3 3 FF3 **Lower-dimensional dispersive transport in Cd(S, Se) nanocrystallite doped glasses**, G. Beadie,* E. Sauvain,** N. M. Lawandy, *Department of Physics and Division of Engineering, Brown University, Providence, RI 02912.* Stretched exponential relaxation of photoexcited carriers in different Cd(S, Se) nanocrystallite doped glasses is observed. The temperature dependence of fitting parameters from 4-4600 K indicates two different temperature regimes of recombination behavior. We discuss this behavior in terms of a physical picture of carriers exhibiting dispersive transport at the nanocrystallite glass interfaces.
**Department of Physics. **Department of Engineering.*

9:45
Q3 4 FF4 **High-speed time-domain holographic image storage**, X. A. Shen, Y. S. Bai, R. Kachru, *Molecular Physics Laboratory, SRI International, 333 Ravenswood Avenue, Menlo Park, CA 94025. E-mail: shen@mplvax.sri.com.* We report the storage of 40 frequency-multiplexed, time-domain image holograms in a Eu^{3+}:Y_2SiO_5 crystal at a speed of 100-μs per frame by using a spatial light modulator. The retrieved images were found to be of high fidelity and show no evidence of crosstalk.

SESSION Q'2 [FK]: JOINT SYMPOSIUM ON SINGLE MOLECULE SPECTROSCOPY: 1
Friday morning, 7 October 1994
Loews Anatole Hotel
Topaz Room at 9:00
William E. Moerner, presiding

9:00
Q'2 1 FK1 (Invited) External field effects and imaging of single molecules in solids, Urs P. Wild, *Physical Chemistry Laboratory, Swiss Federal Institute of Technology, CH-8092 Zürich, Switzerland. E-mail: wild@ppc.lpc.ethz.ch.* Single molecules trapped in solids are highly-sensitive probes to test local environments and the effect of external perturbations such as electric fields or pressure applied to the sample. A microscope setup allowing for real-time imaging of single-Ωuorescing molecules has been developed. Video data showing light-induced transition frequency jumps of a single molecule are presented and illustrate local changes of the environment.

9:30
Q'2 2 FK2 (Invited) Spectral diffusion of individual molecules in solids: theory and experiment, J. L. Skinner, Philip Reilly, *Department of Chemistry, University of Wisconsin, Madison, WI 53706. E-mail: skinner@chem.wisc.edu.* A general theory of spectral diffusion in disordered crystals is discussed. With this theory the experimental spectral diffusion trajectories of individual pentacene molecules in p-terphenyl crystal obtained by Moerner and coworkers are analyzed. Our results yield detailed information about the two-level systems responsible for the spectral diffusion.

10:00—Coffee Break

SESSION R6 [FP]: JOINT SYMPOSIUM ON MANIPULATION OF ATOMS BY LIGHT: COLD COLLISIONS: 2
Friday morning, 7 October 1994
Loews Anatole Hotel
Governors Lecture Hall at 10:30
John Weiner, presiding

10:30
R6 1 FP1 (Invited) Radiative escape collisions of laser-cooled atoms, Y. B. Band, I. Tuvi, K.-A. Suominen,* K. Burnett,* P. S. Julienne,** *Departments of Chemistry and Physics, Ben-Gurion Univeristy, Beer Sheva 84105, Israel. E-mail: band@bguvms.bgu.ac.il.* We apply an adiabatic optical Bloch equation (OBE) model for describing radiative escape of laser-cooled Cs atoms and compare the results with a fully-quantum mechanical-complex potential treatment, a semiclassical Landau-Zener model with decay incorporated, and a fully quantum Monte-Carlo time-dependent calculation.
**University of Oxford, UK. **National Insitute of Standards and Technology.*

11:00
R6 2 FP2 Novel intensity dependence of ultracold collisions involving repulsive states, Samir Bali, Dominik Hoffmann, Thad Walker, *Department of Physics, University of Wisconsin, 1150 University Avenue, Madison, WI 53706. E-mail: samirbal@macc.wisc.edu.* Measurements of the laser intensity dependence of excited-state ultracold collision rates involving *repulsive* molecular states of ^{85}Rb are presented. Recent models predict that for high intensities the collision rates *decrease* with increasing intensity. We observe this striking effect and find it in quantitative agreement with the models.

11:15
R6 3 FP3 Minimizing the effects of hyperfine interactions on collisions between optically-trapped atoms, T. Walker, D. Hoffmann, M. Peters,* J. Tobiason,** *Department of Physics, University of Wisconsin, 1150 University Avenue, Madison, WI 53706. E-mail: walker@uwnuc0.physics.wisc.edu.* Measurements of $P_{1/2}$ excited-state collision rates of optically-trapped rubidium are reported. For $P_{1/2}$ states the hyperfine splittings are large, resulting in simple structure of the potential curves, and allowing comparison with models. These ideas are supported by the absence of an isotopic effect in the measured collision rates.
**Rijks Universiteit Utrecht, The Netherlands. **Sandia National Laboratories.*

SESSION R1 [FQ]: JOINT SYMPOSIUM ON HIGH-FIELD LASER-MATTER PHYSICS: ATOMS AND MOLECULES 2
Friday morning, 7 October 1994
Loews Anatole Hotel
Senators Lecture Hall at 10:30
Wendell T. Hill, presiding

10:30
R1 1 FQ1 (Invited) H_2^+ in intense radiation fields: from exotic decomposition to stabilization, André D. Bandrauk, Stephan Chelkowski, Tao Zuo, *Laboratoire de Chimie Théorique, Université de Sherbrooke, Quebec, J1K 2R1, Canada. Bitnet: kcya@udesvm.* At intermediate laser intensities (10^{13}-10^{14}W/cm^2), laser-induced stabilization can manifest itself as dissociation suppression and occurs by laser-induced avoided crossings between dressed molecular surfaces.[1] The role of ionization on such stabilization has been considered in a full electron-proton dynamical calculation. A comparison is made with static nuclear calculations in order to assess the coupling between electronic and nuclear motion on vibrational trapping and high-order harmonic generation. Finally, results of molecular stabilization by field-induced electron localization are shown to occur for super-intense electromagnetic fields, i.e., $I \geq 10^{18}$ W/cm^2 and short wavelengths, $\lambda \leq 50$ nm.
1. A. D. Bandrauk, *et al.*, Laser Phys. 3, 381 (1993); Phys. Rev. **48A**, 2145 (1993).

11:00
R1 2 FQ2 Absolute conversion efficiency measurements of very high-order harmonic radiation, T. Ditmire, J. K. Crane, H. Nguyen, L. B. DaSilva, M. D. Perry, *Lawrence Livermore National Laboratory, P.O. Box 808, L-443, Livermore, CA 94550.* High-order harmonic radiation with photon energies of greater than 100 eV can be generated by short pulse lasers of modest size. Recent measurements of the absolute conversion efficiencies of these harmonics at photon energies out to 70 eV are presented. We have measured harmonic yields as high as 25 nJ at photon energies of 54 eV produced by ~ 1.5 J of laser light at 527 nm. This corresponds to an absolute conversion efficiency of greater than 10^{-8} of the laser light into a harmonic.

11:15
R1 3 FQ3 (Invited) Control of atoms and molecules with phase-coherent two-color radiation fields, P. H. Bucksbaum, D. W. Schumacher, *Department of Physics, University of Michigan, Ann Arbor, MI 48109-1120. E-mail: phil@gomez.physics.lsa.umich.edu.* We have controlled strong-field laser-atom and laser-molecule processes such as above-threshold ionization, molecular bond-softening, and above-threshold dissociation, by employing 2-color high-intensity radiation fields. These experiments test proposed semiclassical models of ATI, and also examine coherence in strong-field atomic physics.

SESSION R2 [FR]: SYMPOSIUM ON SINGLE-MOLECULE SPECTROSCOPY: 2
Friday morning, 7 October 1994
Loews Anatole Hotel
Topaz Room at 10:30
Presider to be announced

10:30
R2 1 FR1 (Invited) Correlation effects in single-molecule fluorescence, M. Orrit, J. Bernard, L. Fleury, R. Brown, *University of Bordeaux and CNRS, 351 Cours de la Libération, 33405 Talence, France.* Fluorescence excitation spectra of small and dilute samples show the narrow lines of individual impurity molecules. The selection of a single molecule allows for strong correlation effects, which would vanish for large ensembles. The autocorrelation of the intensity gives information on the internal relaxation within the molecule, and on the dynamics of the surrounding matrix.

11:00
R2 2 FR2 (Invited) Vibrational spectroscopy of single molecules in solids, Anne B. Myers, Paul Tchénio,* Marek Z. Zgierski,** W. E. Moerner,*** *Department of Chemistry, University of Rochester, Rochester, NY 14627-0216. I: amye@db2.cc.rochester.edu.* Vibrationally-resolved dispersed fluorescence spectra of single molecules of terrylene in polyethylene at 1.5 K are presented. Large variations in vibrational frequencies and vibronic intensities among molecules reveal a wide range of microenvironments available to the chromophore. Prospects for refinement and extension of the technique are discussed.
**Laboratoire A. Cotton, CNRS II, Université Paris XI, France. **Steacie Institute for Molecular Sciences, National Research Council, Canada. ***IBM Almaden Research Center.*

11:30
R2 3 FR3 Probing single-molecule dynamics, X. Sunney Xie, Robert C. Dunn, *Pacific Northwest Laboratory, Molecular Science Research Center, P.O. Box 999, Richland, WA 99352. E-mail: xs_xie@pnl.gov.* The room-temperature dynamics of single-dye molecules dispersed on glass surfaces are investigated on the 10^{-2}-to-10^{2} second and the picosecond-to-nanosecond time scales using a near-field fluorescence microscope. The time-resolved experiments on a single-molecule basis provide new physical insights on spectral diffusion and excited-state energy transfer processes.

11:45
R2 4 FR4 Saturation and near-field spectroscopy of single molecules, W. E. Moerner, Taras Plakhotnik,* Thomas Irngartinger,* Urs P. Wild,* Dieter Pohl,** *IBM Almaden Research Center, San Jose, CA. E-mail: moerner@almaden.ibm.com.* Two recent advances in single-molecule spectroscopy in solids (SMS), an improved saturation analysis including the dipole radiation pattern which allows determination of the orientation of a single molecule, and the results of recent experiments with pulled fiber tips as subwavelength light sources for SMS at liquid helium temperatures are reported.
**Laboratory of Physical Chemistry, ETH-Zürich, Switzerland. **IBM Zürich Research Laboratory, Rüschlikon, Switzerland.*

SESSION R3 [FS]: LINEAR AND NONLINEAR OPTICAL PROPERTIES AND MATERIALS
Friday morning, 7 October 1994
Loews Anatole Hotel
Sapphire Room at 10:30
Presider to be announced

10:30
R3 1 FS1 Transient mirrorless bistability in a Benzporphyrin compound, F. J. Aranda, D. V. G. L. N. Rao, D. E. Remy,* M. Nakashima,* J. F. Roach,* *University of Massachusetts, Boston, MA 02125.* Transient all-optical mirrorless bistability due to increasing absorption is observed for a Benzporphyrin compound in solution in tetrahydrofuran with nanosecond laser pulses.
**U.S. Army Natick Research, Development and Engineering Center.*

10:45
R3 2 FS2 Large third-order nonlinearities of metal-free phthalocyanines films, Hossin Abdeldayem, Curtis Banks, Roslin Hicks, Benjamin G. Penn, Donald O. Frazier, *NASA-Marshal Space Flight Center, Space Science Lab, ES 75, Building 4481, Huntsville, AL 35812.* The third-order optical susceptibilities ($\chi^{(3)}$) were measured by degenerate four-wave mixing at 532 nm for a set of metal-free phthalocynines films. The films, prepared by vapor deposition at 300°C, range in thicknesses between 500 and 9000 Å. The largest value of $\chi^{(3)}$ (4.8 x 10^{-7}esu) was measured at ~ 600 Å thick film.

11:00
R3 3 FS3 Nonlinear optical measurements on molybdenum-based metal-organics, Tiani Zhai, Chris M. Lawson, Guy E. Burgess, David C. Gale, Gary M. Gray,* *Department of Physics, University of Alabama at Birmingham, 1300 University Boulevard, Birmingham, AL 35294-1170. E-mail: lawson@phy.uab.edu.* Independent degenerate four-wave mixing and *z*-scan techniques were used to measure the third-order susceptibility versus concentration for a number of molybdenum-based metal-organic complexes. This concentration dependence yielded the second-order hyperpolarizability for these complexes.
**Department of Chemistry.*

11:15
R3 4 FS4 Study on orientational phase transition in fullerene films by monitoring second-harmonic generation, Yanghua Liu, Hongbing Jiang, Jiabiao Zheng, Wencheng Wang, *Laboratory of Laser Physics and Optics, Fudan University, Shanghai 200433, China.* The second-order susceptibility of C_{60} films was derived from the transmission second-harmonic SH signal, and the orientational phase transition was observed by monitoring the reflection SH signal.

11:30
R3 5 FS5 Temporal nonlinear optical resposnes of C_{60}- and C_{70}-toluene solutions, R. Dorsinville, Lina Yang, R. R. Alfano, *Institute for Ultrafast Spectroscopy and Lasers, Center for Advance Technology for Photonic Materials and Applications, Center for Analysis of Structures and Interfaces, Departments of Electrical Engineering and Physics, The City College and Graduate Center of the City University of New York, 138th and Convent Avenue, New York, NY 10031. E-mail: ees2c5@engr.ccny.cuny.edu.* Optical nonlinear response from C_{60}- and C_{70}-toluene solutions were studied using femtosecond and picosecond four-wave mixing techniques. The dynamics exhibit a strong dependence on the excitation energy. A theoretical model is proposed to describe the experimental results.

11:45
R3 6 FS6 Z-scan and optical limiting using elliptical Gaussian beams, S. M. Mian, J. P. Wicksted, D. H. Blackburn,* *Center for Laser Research and Department of Physics, Oklahoma State University, Stillwater, OK 74078. E-mail: JPW519@vms.ucc.okstate.edu.* Z-scan and optical-limiting experiments are analyzed for an elliptical Gaussian beam. A geometric optics model including nonlinear absorption is developed and the role of eccentricity of the beam is demonstrated. The model agrees well with experimental data taken from a lead glass sample.
**National Institute of Standards and Technology.*

12:00
R3 7 FS7 Ellipsometric and structural analyses of nitrogen-doped amorphous hydrogenated carbon films, J. N. Johnson, R. Ramamurthi, A. J. Cunningham, D. M. Byrne, *University of Texas at Dallas, Richardson, TX 75083. E-mail: jjohnson@utdallas.edu.* Amorphous hydrogenated carbon nitride films are grown by PECVD in which N_2 is added to the $CH_4/H_2/Ar$ gas mixture. The ellipsometric properties of the resulting films are determined by multi-angle, dual wave-length analyses. Correlations between the optical properties, film structure, and deposition parameters are presented.

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CALENDAR OF MEETINGS

APS Meetings

Particles & Fields
2–6 August 1994
Albuquerque, NM
Abstract Deadline: 1 July 1994
Contact: DPF '94 Coordinator
Department of Physics and Astronomy
The University of New Mexico
Albuquerque, NM 87131-1156
Tel: (505) 277-2075
Fax: (505) 277-1520
E-mail: dpf94@unmb.unm.edu

Laser Science (Joint with OSA)
2–7 October 1994
Dallas, TX
Abstract Deadline: 11 April 1994
Contact: OSA Meetings Department
2010 Massachusetts Avenue, NW
Washington, DC 20036
(202) 223-0920

Ohio Section
14–15 October 1994
Toledo, OH
Contact: Scott Lee
Department of Physics and Astronomy
University of Toledo
2801 W. Bancroft Street
Toledo, OH 43606
(419) 537-4779

Texas Section
14–15 October 1994
Austin, TX
Contact: Dr. Carroll A. Quarles, Jr.
Department of Physics
Texas Christian University
Fort Worth, TX 76129
(817) 921-7375

Nuclear Physics
26–29 October 1994
Williamsburg, VA
Abstract Deadline: 17 June 1994
Contact: Dr. Virginia R. Brown
Lawrence Livermore National Laboratory
L-297, E Division
P. O. 808
Livermore, CA 94550
(510) 422-4092

Southeastern Section
10–12 November 1994
Newport News, VA
Abstract Deadline: 2 September 1994
Contact: Dr. Cecil G. Shugart
Memphis State University
Department of Physics
Memphis, TN 38152
(901) 678-3121

Plasma Physics
7–11 November 1994
Minneapolis, MN
Abstract Deadline: 8 June 1994
Contact: Meetings Department
APS, One Physics Ellipse
College Park, MD 20740-3844
(301) 209-3200

Fluid Dynamics
20–22 November 1994
Atlanta, GA
Abstract Deadline: 5 August 1994
Contact: Dr. G. Paul Neitzel
Georgia Institute of Technology
School of Mechanical Engineering
Atlanta, GA 30332-0405
(404) 894-3242

March Meeting
19–24 March 1995
San Jose, CA
Contact: Meetings Department
APS, One Physics Ellipse
College Park, MD 20740-3844
(301) 209-3200

Joint April Meeting with AAPT
18–21 April 1995
Washington, D. C.
Contact: Meetings Department
APS, One Physics Ellipse
College Park, MD 20740-3844
(301) 209-3200

Atomic, Molecular, and Optical Physics (Joint with Atomic Molecular Physics)
17–19 May 1995
Toronto, Canada
Contact: Dr. A. David May
Department of Physics
University of Toronto
60 St. George Street
Toronto, Ontario MS5 1A7 Canada
Fax: (416) 978-5848

Sponsored Meetings

11th Int'l Conference on High Magnetic Fields in Semiconductor Physics
8–12 August 1994
Cambridge, MA
Contact: D. Heiman
Francis Bitter Nat'l Magnet Lab
MIT, NW 14-4121
Cambridge, MA 02139-4307

Int'l Conference on Strongly Correlated Electron Systems
15–18 August 1994
Amsterdam, The Netherlands
Abstract Deadline: 1 April 1994
Contact: Dr. A. de Viser
SCES '94 Conference Secretary
Van der Waals—Zeeman Laboratorium
Universiteit van Amsterdam
Valckenierstraat 65
1018 XE Amsterdam,
THE NETHERLANDS
Tel: 31-20-5255732/5716
Fax: 31-20-5255788

8th Int'l Conference on Quantitative Surface Analysis (QSA-8)
23–26 August 1994
Surrey, U.K.
Contact: Christopher P. Hunt
Division of Materials Metrology
National Physical Laboratory
Teddington, Middlesex
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Telephone Inquires to Doreen Tilbrook
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Fax: 081-943-2989 or +44 81 943 2989

7th Conference on Superconductivity and Application
7–9 September 1994
Buffalo, NY
Contact: Barbara Routhier
New York State Inst on Superconductivity
State University of New York—Buffalo
330 Bonner Hall
Buffalo, NY 14620
Tel: (716) 645-3114
Fax: (716) 645-3349

Int'l Symposium on High Energy Spin Physics and Polarization Phenomena in Nuclear Physics
15–22 September 1994
Bloomington, IN
Contact: Janet Meadows
Indiana University Cyclotron Facility
2401 Milo B. Sampson Lane
Bloomington, IN 47408
Tel: (812) 855-9365
Fax: (812) 855-6645

The Second Int'l Conference on Research and Communications in Physics (RACIP2)
18–22 September 1994
Tokyo, Japan
Contact: Secretariat of RACIP2 Organizing Committee
The Physical Society of Japan
Kikai-Shinko Bldg., Room 21
Shiba-Koen 3-5-8
Minato-ku, Tokyo 105 JAPAN
Tel: 81-3-3434-2671
Fax: 81-3-3432-0997
e-mail: racip2@atlas.phy.metro-u.ac.jp

Canadian–American–Mexican Meeting of the Physical Societies (CAM94)
26–30 September 1994
Cancun, Mexico
Contact: Dr. Arnulfo Zepeda
Centro de Investigacion y de Estudios Avanzados del I.P.N.
Departamento de Fisica
Apartado Postal 14-470
MEXICO 07000, D.F.

47th Annual Gaseous Electronics Conference
18–21 October 1994
Gaithersburg, MD
Abstract Deadline: 8 July 1994
Contact: Jean W. Gallagher
Bldg. 221, Rm. A 323
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Gaithersburg, MD 20899-0001
Fax: (301) 926-0416
e-mail: jwg@enh.nist.gov

4th Conference on Radiation Protection and Dosimetry
24–27 October 1994
Orlando, FL
Contact: J.S. Bogard
ORNL
P.O. Box 2008
Oak Ridge, TN 37831-6379
Tel: (615) 574-5851
Fax: (615) 574-9174

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